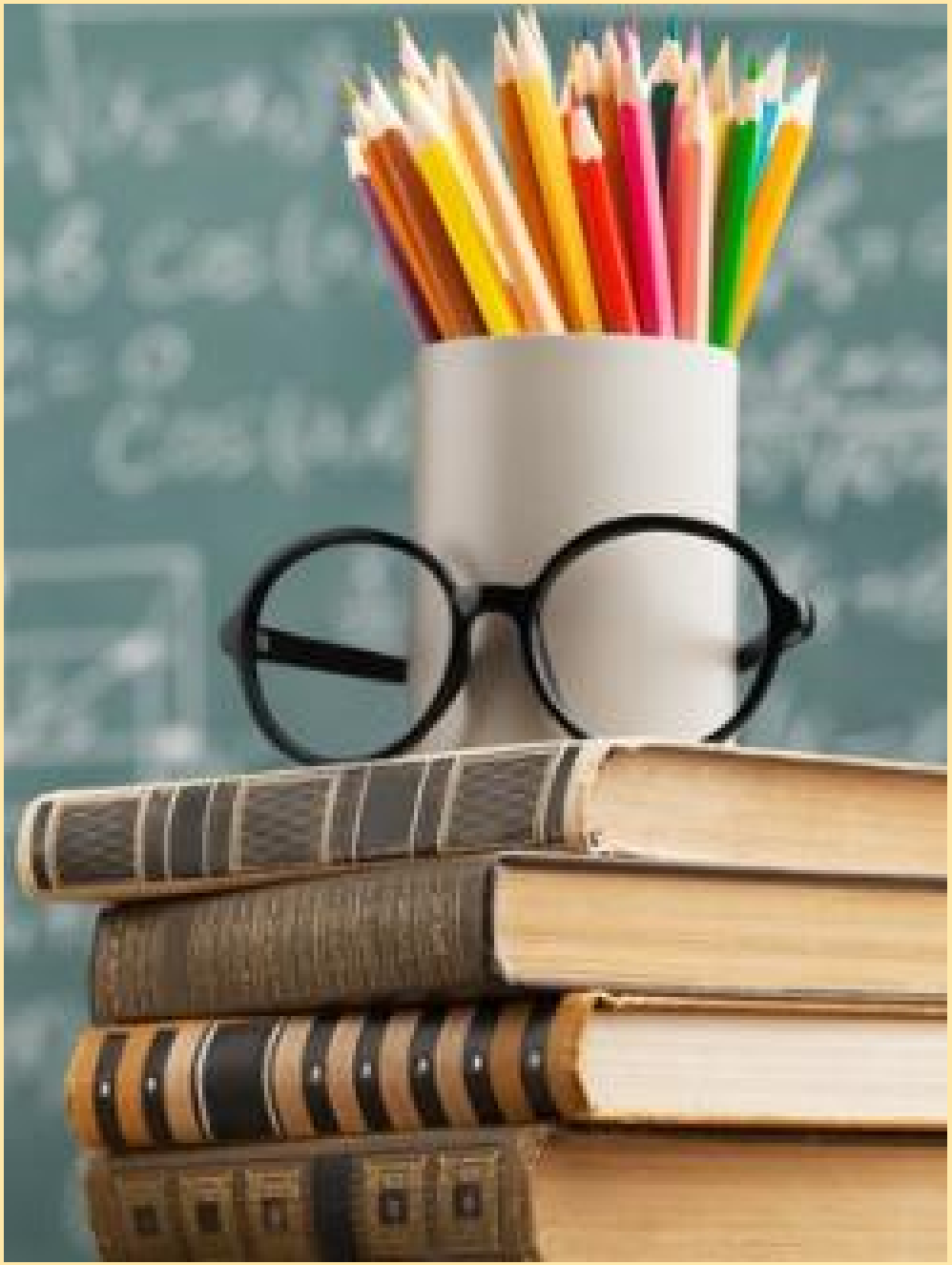

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE,
PILANI
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MANTHAN

Churning knowledge
from the depths

Presented by

Teaching Learning Centre

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EDITORIAL

Prof. Rahul Nigam, Department of Physics

The Ever-Evolving Journey of a Teacher

Teaching is not a static profession; it is an evolving craft that thrives on continuous learning. Educators, in their role as mentors and guides, must embrace change as an inevitable part of their journey. With time, societies progress, student perspectives shift, technological innovations reshape classrooms, and curricula undergo constant refinement. These transformations are not anomalies but rather the rhythm of the education landscape worldwide. As a collective force shaping future generations, educators bear the responsibility of fostering environments that nurture curiosity, critical thinking, and lifelong learning. This calls for a spirit of constant reflection and reinvention. The ability to pivot, to explore new methods, and to integrate emerging tools is not just beneficial but essential.

At the heart of this commitment lies the Teaching and Learning Centre, dedicated to equipping educators with the insights and resources needed to navigate this ever-changing landscape. It is with great enthusiasm that we present this edition of Manthan, a curated collection of reflections, research, and experiences contributed by our faculty. Spanning a wide array of perspectives on education, these articles offer invaluable discourse on contemporary pedagogy, innovation, and the purpose of teaching itself.

The overwhelming response to our article-writing competition affirms the deep engagement of our faculty in shaping the academic experience. We extend our heartfelt gratitude to all contributors, jury members, and the dedicated team behind this initiative.

A sincere thank you is also due to the entire TLC team for their unwavering collaboration, particularly to Prof. Bhanumurthy, Prof. Thiruvikraman, Prof. Tathagata, Prof. Sudha Radhika, Prof. Barsha, and Prof. Kirtimaan for their contributions in shaping this magazine.

We continue to hope that Manthan becomes a platform for ongoing dialogue, a space where educators can share, reflect, and inspire one another. We invite more voices to join this conversation and look forward to even greater participation in the future.

Together, as educators, we learn, evolve, and shape the minds of tomorrow.

OUR WINNERS

Prof. Nitish Kumar Gupta – How to Promote a Scientific Temper?

I have been a power system professional, and till a few years back, I was at NTPC Ltd. But my love for teaching, learning, and sharing knowledge inspired, or rather drove me towards academia. For me, the preparation of every lecture is a chance to bring knowledge to life, which, because of its innate nature, is an evolutionary process with cycles of learning and unlearning. While executing the lecture, I incorporate discussions of pioneering figures, their work, thought processes, and contributions. I also strive to integrate demonstrations and turn them into discussions, as this process refines and elevates both the teacher and the student alike.

Prof. Anasua Guharay – “Holding Students Accountable”

The road to success is always under construction – Being a faculty of Civil Engineering, my teaching in class always focuses on connecting with the real world. I try to integrate real-world case studies, design projects, and site visits to demonstrate how theoretical knowledge translates into practical engineering solutions. Discussing professional ethics in engineering practice, including safety regulations, environmental impact, and responsible decision-making always go hand-in-hand with my teaching in class. I always prefer teaching on a blackboard and make sure that the learning is never one way. I try to make my classes as participatory as possible. For me, the key to interactive teaching is to keep abreast of advancements in civil engineering technology, materials, and industry practices to incorporate relevant information into my teaching.

Prof. Dipanjan Chakraborty – “Managing Large Computer Science Courses: A Fine Balance Between Aspirations and Practicality”

Dipanjan came into this profession because of his love for teaching but is currently disturbed by the growing class sizes, disinterested students and academic administrators who do not analyse the root problems. He does not believe that proctored examinations should be a large part of course evaluations, and hates grading exam papers. He is yet to hit the sweet spot where one does the 'right' things and yet gets good feedback scores from students. When he is not cribbing about everything that is wrong with the 'system', he dabbles in Human Computer Interaction as a research area, and watches videos of trains on YouTube.

WHAT IS THE PURPOSE OF EDUCATION?

–Prof. Amit Nag, Department of Chemistry

The answer of this question lies deeply rooted in the various existing layers in our society. I remember back in high school, I was never really the academic type. My grades were decent, but I was more interested in spending time with friends in the ground and playing cricket or football. I ended up studying chemistry and decided to do higher studies with it. During My MSc. at Jadavpur University at Kolkata or my PhD days at IIT Kanpur, I worked alongside people from various backgrounds who had incredible stories and knowledge. I started to realize that education isn't just about textbooks and grades-it's about engaging with the world, learning from different experiences, and growing as a person. Broadly, the purpose of education is to create well-rounded individuals who can think critically, act responsibly, and contribute meaningfully to society, while also ensuring their personal growth and fulfilment. However, let us discuss about other facets of education in today's world. The three most important aspects that can be pondered upon are – access of proper education to all, how to make the next generation AI ready and lastly, how young stars circumvent social media in the post-truth era.

Nowadays, good education at top notch intuitions in India and across the world, requires a lot of money. The question is, how can a day labourer give that equivalent education to his or her child? Poverty is the biggest curse, but at the same time the biggest weapon of a poor person is education. By gaining, proper education he or she can change his own future. A child born in a poor family, most of the times, does not get good opportunities due to lack of money. However, introduction of generous scholarships in educational institutions to needy candidates has improved the situation. Why only poor? The son of a big businessman will also not be able to sustain his business unless he does not get relevant training and education to run the show. Without education no one will be able to move forward in life – rich, middle class and also poor. There is no exception. Now, let us come back to the important question– does education mean school or college education? There are three types of education. 1) Learn through hands-on experience. 2) Learn in school or college. 3) Learn from different people. #2 is very important for the school students, however for the college and university students, along with the classroom teaching, we need to give them enough time to learn via #1.

Those who have money are getting benefits here. In India, apart from IITs, IISERs, IISc etc. our government education is broken. But what about the government? It was made by us, the people of India. Therefore, fundamental reform of the education system is required. As a private institution, BITS Pilani takes the legacy and has shown the correct path with their innovative education system which amalgamates all of the above three points. But such examples are rare in India.

Now, let us discuss the future of our children in the AI era. "What will be the future of our children in this AI-driven world?" Questions like these often come from thoughtful, educated parents: when my child grows up how will the job market be then? Will AI take over coding and make computer science degrees less valuable? Should we focus on data science, or will AI do it? We are not astrologer to answer all these questions, and it is difficult to say for sure how the future will be in 10-20 years. But there are certain things which we can analyse. Today's world is gradually dividing into two parts, especially in last 2-3 years - Cyber World, where data, digital systems, and virtual networks rule; And the physical world, where human interaction, creativity and sensory experience is important. Cyber-stored data processing and analysis is obviously faster than humans, where efficient bots and algorithms will be generated and they will be ahead compared to humans. But, the trick is: AI does not have direct access to the physical world. The beauty of nature, the emotions of humans, and the confusion of creativity-AI is still far away from all this. In this situation the role of human will be very important. The human intervention will remain unchanged in these places: to feel and find out the meaning of love, art, music, and the beauty of nature. Also, solving real-world challenges like climate change or mental health.

Therefore, modern education should be such that it brings innovations at the crossroads of cyber and physical worlds, which will improve the quality of life. The future job will probably depend on being a connector between these two worlds-how can we use AI as a tool on physical experience-based problem solving. So how to prepare children for this future? The source of the answer is hidden in the past- Holistic Education. Hands-on learning and integration with nature is must. We need to learn Music, Art, Literature, Science, and Math, everything interactively. One should not learn only just abstract concepts, one must understand the world and the people around them. We need to develop the critical thinking and spirit of entrepreneurship in the young minds. They should develop a habit of understanding the problems around us and finding solutions to improve the quality of life. AI should not be seen as a threat, but as a tool. We need to train our kids how to "speak" with AI, by adhering its potential and also the limitations. One of the important purposes of today's education should be to develop the ability among students to use AI as a friend. The worlds of tomorrow will be built around improving the lives of people, where cyber and the physical world will work together. Let us not involve in a duel with machines, rather, with their help the real potential of human intelligence can be improved. Let's encourage our children to think differently, create, and fully embrace their human side.

I finish with some discussion on 'Post-Truth Era', which can be easily followed these days on social medial platforms. Today's world has come to a place where personal opinion is more important than truth and lie. And faith becomes more important. Let us call it 'Post-Truth Era'. Arguing about truth in this era is like joining a Facebook group "My mother cooks better than everyone else."

Quite naturally everyone will say, “Our mother is the best!” But here is the problem. The more innocent is the argument about something as innocent as cooking, the more dangerous are the topics of post-truth. Let's take an example to see how post-Truth has changed us. When it comes to the topic of Nobel laureates Amartya Sen and Dr. Yunus, then his supporters fight as if the guru is on one side and the younger uncle is on the other side. Supporters think that their favourite personality is the only right one. One day a supporter was asked, “What is the basic policy of Yunus’ Grameen Bank?” The answer came, “I don't know. But he is great!” Similarly, one of the supporters of Amartya Sen was asked, “What are his economic theories?” “Has it actually happened?” He replied, “No, but he is amazing!” This is post-truth. There is no logic behind personal belief. That belief gets stronger just by scrolling through Facebook. Hope, our young stars can educate themselves in such a way that they can correctly differentiate between the truth and lie in this volatile period across the globe.

“TEACH OR TRAIN: STRIKING THE BALANCE FOR HOLISTIC STUDENT GROWTH”

– Prof. Anakhi Hazarika
Department of Electrical and Electronics Engineering

In today’s ever-evolving educational landscape, teachers hold a pivotal role in shaping the future. To build a strong foundation for their students, they must not only possess deep knowledge but also employ effective strategies to engage and inspire. Within the broad spectrum of education and personal development, two key approaches stand out: teaching and training. While these methods often overlap and complement one another, understanding their distinctions and the unique benefits each provides is essential. The timeless saying, "teach to learn and train to experience" aptly encapsulates the essence of these approaches, highlighting their philosophical foundations and transforming education into a dynamic, impactful process. For educators, this means embracing continuous growth, adopting innovative methodologies, and cultivating a classroom environment that balances support with challenge.

Teaching: The Foundation of Learning

Teaching is often considered as the cornerstone of education. It focuses on helping learners grasp new concepts, ideas, and theories while emphasizing cognitive development. It involves imparting knowledge, sparking curiosity, and encouraging students to think critically about the world around them. Teaching seeks to answer the "why" behind concepts, helping students make connections, and encouraging them to explore ideas beyond the surface. Teaching fosters critical thinking by honing students' reasoning and analytical skills. For instance, in a history lesson, teaching doesn’t merely recount events but delves into their causes, consequences, and relevance to the present. Additionally, teaching encourages exploration by going beyond textbooks, urging students to ask questions and seek answers independently. By focusing on core concepts and their applications, teaching prepares students to embrace new knowledge and adapt to evolving ideas throughout their lives.

Training: The Bridge to Experience

Training, in contrast, focuses on action and repetition, aiming to build specific skills and competencies. While teaching provides a foundational understanding, training ensures that students can effectively apply their knowledge in real-world scenarios. It involves hands-on practice, guided learning, and immediate feedback, whether it is solving problems, conducting experiments, or delivering a presentation. Training bridges the gap between theory and practice. For example, understanding the mechanics of driving a car can be taught through road safety lessons, but driving confidently requires hours of behind-the-wheel practice to master control and reaction in real traffic situations. With consistent practice and constructive feedback, students gain confidence in performing tasks accurately and efficiently. Training is typically goal-driven, designed to ensure that the trainee can carry out a particular task or activity with proficiency.

Balance between Teaching and Training

Teaching and training are not mutually exclusive. They are complementary strategies that, when integrated, provide students with a well-rounded education. Overemphasizing teaching may leave students with knowledge but no practical ability to apply it, while focusing solely on training might result in skill proficiency without a deeper understanding of the subject. Deciding whether to teach or train depends on the lesson's objectives and the student's needs, as each approach serves distinct purposes. Teaching is ideal for fostering understanding and encouraging exploration, while training is essential for mastering specific tasks or skills.

The choice also depends on the learner's level: beginners often require teaching to grasp foundational concepts, while advanced learners benefit from intensive training to refine their abilities.

Also, every student learns differently, some may need more teaching to understand a concept, while others may benefit more from skill-focused training. The subject matter further influences this decision, for instance, in mathematics, teaching explains the "why" behind formulas, whereas training involves repeated problem-solving for proficiency. Similarly, in science, teaching introduces theories, while training emphasizes experiments and data interpretation. Often, the most effective method combines both approaches, for example, teaching grammar and vocabulary in language learning provides a foundation, while training through conversations ensures fluency. Recognizing the distinction between teaching and training is essential for educators, trainers, and learners, as it allows for creating comprehensive learning experiences that impart knowledge and build real-world skills. Together, teaching to learn and training to experience form a harmonious balance, integral to personal and professional growth.

Role of the Educator

In today's rapidly evolving world, educators must go beyond being mere sources of knowledge. They must serve as guides, mentors, and motivators, helping students navigate the complexities of a constantly changing environment. This demands a robust foundation in both theory and practice, bridging the gap between what is taught in teacher training programs and what happens in the real-world classroom.

The challenge for teachers is not choosing one approach over the other but knowing how to blend teaching and training to create a comprehensive and impactful learning experience for students.

A successful educator adapts their methods based on the topic, the students, and the desired outcomes. One effective strategy to integrate teaching and training is the Teach First, Then Train approach: start by teaching concepts, then reinforce understanding through hands-on training. For example, in a writing class, teach the structure of an essay, then train students by having them write essays with constructive feedback. Similarly, incorporating project-based or problem-based learning merges teaching with training, allowing students to learn concepts through instruction and apply them to real-world scenarios through practice. However, some students may need more emphasis on conceptual teaching, while others may need more training in specific skills. A flexible teacher adapts to these needs, switching between teaching and training depending on the subject matter and the student's level of understanding. For example, when teaching a new concept, a teacher may start with instruction, and then shift to skill-based activities that give students the opportunity to apply their learning. Regardless of the approach, whether teaching or training, providing feedback is crucial. In teaching, feedback helps students refine their understanding and deepen their intellectual engagement, while in training, it helps students to improve their skills and performance. By providing consistent, constructive feedback, teachers help students grow both intellectually and practically.

The synergy of teaching and training creates a dynamic and powerful learning experience for students. This holistic approach ensures that students are not only knowledgeable but also capable and more confident in their abilities. The knowledge gained from teaching provides the foundation, while the practice gained through training builds the confidence necessary for students to take on challenges. This method ensures that students are prepared for the real world. Whether it is in the workforce, higher education, or day-to-day life, students who have been both taught and trained are well-equipped to navigate complex situations, think critically, and perform effectively.

As educators, our responsibility extends beyond delivering information. Our goal is to empower students to think critically, apply what they've learned, and create solutions to complex problems. By embracing both teaching and training in the classroom, we provide a balanced approach that nurtures intellectual development while ensuring practical competency. This dynamic approach equips students with the tools they need not only to succeed in school but to thrive in their personal and professional lives. By knowing when to teach and when to train, we can empower students to become knowledgeable, skilled, and confident individuals ready to take on the challenges of the world. The ability to effectively combine teaching and training is one of the most powerful tools educators possess. By mastering this balance, we can shape the next generation of thinkers, innovators, and leaders, equipping them to thrive in a world full of opportunities and challenges.

“HOLDING STUDENTS ACCOUNTABLE”

-Prof. Anasua Guharay, Department of Civil Engineering

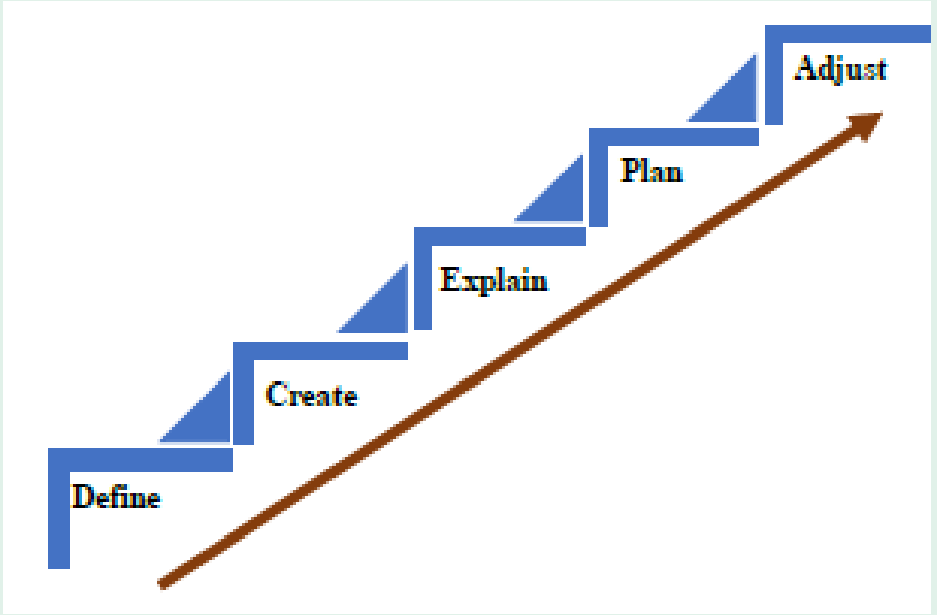
“Accountability build Response-ability” – Steven R. Covey

Do you have a problem if students arrive at your class unprepared, with readings and tasks not finished? Since the activity and in-depth discussion, you had planned for class time, depend on the students having completed the assigned reading or being otherwise prepared for class, you are unable to carry them out.

What do you do? - It goes without saying that you don't want to lecture students over the material you expected them to have prepared in order to demonstrate that they don't need to study for subsequent lessons.

So how can you make sure your students are ready for class? - Using low-stakes "accountability tasks" to hold young people accountable is the solution. All students will be able to take part in and gain from in-class activities that will aid in their learning of the course material if they are given an accountability task.

Planning is necessary if a method of holding students accountable is to be successful. The following is a very popular 5-phase bottom-up model:



Phase 1: DEFINE- the phase for bridging the gap

Define what "good preparation" means in YOUR classroom.

- Before class starts, what should students know, be able to do, or have considered?
- Consider class preparation as students performing lower -level cognitive activities in Bloom's Taxonomy (identifying, recalling, or comprehending a new area) to ensure that your expectations are acceptable.
- The students will be psychologically ready for more challenging tasks as a result.

Phase 2: CREATE- the brainstorming phase for an instructor

Create an "accountability task" with low stakes.

- Accountability assignments can guarantee that students have done their homework. The task can come in the form of a quiz (to be completed in class) or an assignment (to be completed prior to class).
- Although the work needs to be simple, it should be worth one or two points.

Phase 3: EXPLAIN- the most crucial and critical phase.

Explain the "purpose" of the accountability.

- Give your students a clear and concise explanation of the assignment's or quiz's aim, or the accountability approach. This will make it easier for them to relate the assignment to particular future in-class activities and the course's general objectives.
- Clearly and explicitly state what you anticipate.

What should students do, for instance, if you ask them to read a paper or watch a video that illustrates a real-world case study?

1. Should they prepare a summary after extracting the main ideas or arguments?
2. Should they relate the paper's concepts to any previously taught ideas?
3. Do they just need to understand definitions and facts?

The more explicit you are about what you want or anticipate from your students, the more prepared they will be.

- Explain to students how they will learn from your accountability exercise. Make it clear how the accountability task, classroom engagement, and course topic learning are related.
    a. Reading comprehension: This gives students the chance to practise the abilities needed for their course.
    b. Quiz (massed practice): Explain to your students how retrieval practice (quiz) improves learning. The generally acknowledged conclusion that retrieving information from memory enhances long-term memory retention is known as retrieval practice. Regular quizzes improve students' long-term recall of the content by providing retrieval practice.
    c. Assignments spaced out over time (distributed practice): Studies indicate that learning material in multiple sessions over several days improves retention (as opposed to being jammed into a single extended session). Maintaining reading and assignments outside of class is a type of distributed practice that will help with exam preparation in the future.

• Explain to students that by holding them responsible, you may get input on how well they comprehend the material, which can then inform your teaching strategies. The students will better comprehend their role in the learning process if you make this idea clear to them.

P**hase 4: PLAN- homework phase for the instructors**

"Pre-plan your class hours" to deepen student's understanding and ability to engage with the content.

Plan the class period to incorporate tasks that require students to arrive at class prepared. Think about the degree of comprehension or proficiency you hope students will attain as a result of their preparation. Start the lesson at that level and make use of the class period to help students become more knowledgeable and capable of interacting with the material.

- Use class time to help students grasp terms and concepts and demonstrate how they are related or applied if you expect them to just recognise them from a reading without necessarily fully understanding them (for example, presenting scientific terminology in a STEM subject)

- If you anticipate that students possess a strong (albeit fundamental) grasp of the material, then acknowledge that understanding (or verify it with a short activity) at the start of class and progress to more advanced tasks that develop students' readiness, such as reviewing a case study, assessing hypotheses, dissecting a phenomenon or situation, or discussing advantages and disadvantages.

For instance, if students are tasked with studying an article and have an accountability assignment to create a 200-word summary, avoid using class time to explain what the article covers. Rather than beginning with direct instruction, initiate the class with a short exercise where students articulate their viewpoint and reach an agreement; then allocate class time for more intricate tasks, like debating the advantages and disadvantages of the methodology used in the article or relating it to other course materials.

If your accountability task asks students to pinpoint aspects they find confusing in their reading, dedicate class time to offering more instruction on those unclear points.

Phase 5: ADJUST- the phase to make some difficult choices

Students still come to your class unprepared? Try some of the "strategies" listed below:

- Spend some time collecting information. What is the number of students who are unprepared? Are the same few students involved, or do different ones participate each time? Are they unready only on specific days? After collecting this information, engage in a discussion with your class if numerous students are arriving unprepared, or speak to the unprepared students one-on-one if there are only a few. Occasionally, a discussion with a handful of unready students is enough to uncover if they are facing challenges outside of class that impact their studies. If the majority of the class is unready, you may need to repeat your reasoning for why arriving prepared is important. You may also need to hear the students' explanations and reassess your task and your expectations.

- **A**ssess the preparation you anticipate from students and the accountability measures in place. Is the preparation overly challenging? Should the task be organized more clearly or better supported with justification? Is the link between the preparation and classroom activities vague? Are your expectations about students' readiness ambiguous?
- You can choose to continue with your scheduled in-class activity, even if some students are not ready. Declining to teach the content that students haven't studied demonstrates to them that you value preparation. Ensure you converse directly with the prepared students about how their readiness allows them to accomplish the in-class tasks more effectively or efficiently.
- You might consider revising your attendance grades and including “fulfilling accountability tasks” as a component of the overall participation grade. At the start of the semester, you may provide students with a restricted quantity of “appreciation coins.” Each "appreciation coin" permits a student to attend class unprepared for a single day. Permitting your students to utilize “appreciation coin” acknowledges that unexpected events can occur even among the most intelligent and driven learners.
- In certain scenarios, you might instruct unprepared students to finish the accountability task during the class period. If the other students will be using the class time to work in small groups, for instance, you can have the unprepared students sit together and finish their accountability task while the others are working. If they finish the accountability task before the class session concludes, they may join their group to collaborate on the group’s in-class task; if not, they must complete the in-class task independently later. In both situations, you have the option to withhold "participation points" from the unprepared students for that day's class.
- You might feel inclined to disregard unprepared students outside of class or cancel the session altogether if the majority of students are unprepared. Although this reaction from the instructor is reasonable (though emotional), it fails to enable the removed students to learn; furthermore, it might inadvertently encourage the very behavior you're aiming to discourage. If unprepared students continue to appear in your class, you might need to reassess your overall approach and contemplate some tough decisions.

Accountability Tasks

Numerous specific tasks exist to ensure students are held accountable; some are completed outside of class, whereas others are performed during class. The following 2 sub-sections summarise few of them:

Accountability Tasks to be done Before Class

- Reading assessment: A short writing assignment that cannot be finished unless students have completed the required reading. The task may consist of a straightforward prompt (for instance, outline the key ideas of a reading) or can be organized as a “worksheet” for convenient assessment.
- Create inquiries: A task that asks students to generate questions regarding the text. These may be inquiries they anticipate encountering on a test related to the reading (possibly with page citations), or topics they wish the teacher to discuss during the lesson.
- Brief quiz: A quiz with a handful of fundamental questions related to a reading or task, is an especially effective method for assessing understanding of terminology or essential information.

Accountability Tasks to be done In Class

- Muddiest Point: Learners pinpoint particular aspects of the material they find confusing. The inquiries can be introduced in class or shared beforehand in a discussion forum. The students may select which questions they would like the instructor to cover, or the instructor may choose subjects for further teaching.
- In-class assessments or exercises intended to necessitate that students complete the reading to engage effectively in them.
- Holding students accountable to their peers for being ready for class—peer accountability—can be a highly effective approach. Keep in mind that when implementing peer accountability strategies such as those mentioned here, it’s crucial to be open: clarify to students the reason for their discussions with each other. Highlight the advantages of viewing their colleagues as important resources for information and constructive feedback.

- Peer evaluation: Students participate in in-class peer evaluation of the initial drafts of their classmates' essays. In this scenario, if a student arrives at class without a draft, you could have them create their draft during class and subtract the points they could have gained from participating in the peer review
- Altered jigsaw: For material that can be split into distinct subjects, designate a segment of the class to study each subject. In class, form groups where every member specializes in a distinct topic, and have them instruct one another on their designated subject.
- Adjusted team-based learning: Allocate students to teams that remain consistent throughout the semester. Have students complete a quiz during class on their own and submit it. Next, let students retake the quiz in groups and engage in discussions about the questions, completing a scratch-off sheet together to receive instant feedback on their responses. The overall score for each student on the quiz results from the sum of their individual score and the team score.

Concluding Remarks

Ensuring students take responsibility for arriving to class prepared can be difficult—an issue that may not be resolved just by implementing an accountability task. It might require time and a mix of approaches: guaranteeing solid alignment among tasks, classroom activities, and course objectives; being clear about assignments and expectations; refraining from lecturing on material students aren't prepared for; and diversifying your accountability measures to keep students motivated. Moreover, it is influenced by several other aspects like class size, the type and subject matter (theoretical, practical, or application-oriented), course levels (beginner or advanced), and the readiness of students based on their prerequisite studies.

However, tackling this challenge will be rewarding when you observe the outcome: vibrant in-class activities and discussions where every student can participate and contribute. Even with the tough challenges, the sense of making a positive impact on future generations is consistently the most rewarding gift for a teacher.

"The roots below the earth claim no rewards for making the branches fruitful" – Rabindranath Tagore

TEACHING MATTERS (? TO WHOM?)

–Prof. Balasubramanian M,
Department of Electrical and Electronics Engineering,

For centuries now, formal education remains considered the gateway to a better life for oneself and a better future for the society at large. The advances not only in STEM subjects but also in the understanding of the mind, arts, commerce and communication have contributed to the rapidly metamorphosing world that we inhabit today. From the vantage point of the lives of early human beings involving thousands of years of acquiring, mastering and perfecting skills suited for survival being passed down from one generation to the other, the present speed of advances in technologies and human enterprise is certainly break-neck. And knowledgeable people believe – with fair reason – that this speed is only going to increase at unprecedented rates.

As a society, we believe that a good education is a slingshot that can catapult one to help catch up with the cutting edge of these advancements. Right from its etymological meaning, the word 'Education' implies a journey from ignorance to knowledge. With considerable endeavours, the frontiers of knowledge are being tested and moved along every moment of every day, and this makes the challenge of making a person 'fully educated' more acute. The process of teaching, learning and assessing is at the heart of the formal education system. In this essay, we focus our attention on the first of the triumvirate

– Teaching.

Till about a century ago, books were the only source of knowledge and lecturing, was the only (major) form of transmitting this knowledge. Of course, the wider gamut of education also encompasses skills – from simple ones like counting or arithmetic to more complex vocational ones like automobile technician– which were taught through practice in a laboratory or in the field. However, by far the most popular way of teaching was 'lecturing' i.e., reading and explaining a text to students to take them along the journey from ignorance to knowledge in a subject. So deeply embedded has this become in our collective consciousness for centuries that we now equate lecturing with teaching. As the formal education system continues to expand to reach out to sections of the global society who were left behind, we are faced with the challenge of maintaining a good standard of education, implying a good standard of teaching.

My memory of good teaching and thus my inspiration to be a good teacher is in a lecture hall teeming with students, where a wise person held forth during the class always having an ace up her sleeve to bamboozle me with an insight or intuition into the subject matter and wanted me to also desperately learn more. The good classes seemed to pass by in minutes while unfortunately there were a few which seemed endless and too difficult to endure. The beginning of a class posed a question/challenge that we would run into if we only applied what we knew till then. Then majority of the time was spent in setting up the big reveal and explaining why this would work. The end of the class was always a hook to lure us back to the next class for more.

Like most of my cohort, I too was working hard, making copious notes, discussing and debating with friends, poring over the details from the textbooks and trying to assimilate this new insight learnt from a good teacher and imagine what would come next. And most times, in the next class we would still be awe-struck with the brilliance and depth of the subject matter. Upon reflection, I find that these great teachers inspired me on this journey of discovering knowledge in different subjects and thus being educated.

Can I apply this same form of teaching in my class now? There are various reasons why this may not be the case. A lot has been said about the shrinking attention spans and the number of distractions in the literature. If that were the only problem, the default solution would be to then shrink the whole cycle of posing a question and revealing the answer several times in one class instead of one question over several classes. Perhaps this will work! However, there is another important aspect which is being discounted in this. In the present times, every student's sources of knowledge are numerous. Not just the various recorded lectures of pioneers or eminent persons in the field, there are various multimedia sources where some of their peers talk in a more relatable language to share the joy of learning and warn of the potential pitfalls of misunderstanding. Further, in the era of artificial intelligence (AI) based large-language-models (LLMs) and similar tools, every student potentially has a customized AI teacher matched to their learning style and pace. AI can help education actually reach every individual person which is a drawback that a classroom-based lecturing/teaching suffers from.

However much a teacher is a subject matter expert and committed to the student's learning, there will always be a few students whose learning style doesn't match that of the teacher resulting in sub-optimal education. The student feedback mechanisms have also not evolved to account for these changes and thus the feedback scores are unreliable. In the existing education system, AI-based teaching is not recognized in formal education. The AI-based teaching-learning is in fact rightly considered a malaise in the realm of assessment. As per NEP 2020 students are given credit for putting in the learning hours usually mapped to attending classroom lectures. Therefore students also have incentives other than the teaching to attend a class.

All the university-ranking agencies seem content to judge the teaching-learning process at an institute from the faculty-student ratio and the outcomes of the learning demonstrated by the students. The students' learning could very well be despite the teaching of the formally assigned educator – the faculty. The faculty's contribution to research and innovation is tracked and highlighted while comment on the teaching work is next to nothing when the faculty promptly conducts the subject and has an acceptable feedback score to show for it. This again indicates that the existing education system values knowledge generation by its faculty members more than it does knowledge dissemination.

If the quality of teaching in the classroom does not matter to the institutions and accreditation/ranking agencies, and also does not matter as much to students, does it mean that teaching doesn't even matter now? Most teachers will tell you that teaching matters but shouldn't it be discounted as coming from a place of survival instinct? With the advancement of science, the very form of many professions has changed to unrecognizable extents. Is teaching the way we know it – going that way? Many things we adore and even revere have been reduced to relics in a museum while still commanding that reverence. As professionals in the business of teaching and learning, wouldn't it be prudent for us to think and adapt rather than just try and perfect the next PowerPointTM transition?

“MANAGING LARGE COMPUTER SCIENCE COURSES: A FINE BALANCE BETWEEN ASPIRATIONS AND PRACTICALITY”

–Prof. Dipanjan Chakraborty, Department of Computer Science and Information Systems

In recent years, demand for enrolling in computer science courses in undergraduate engineering programmes has increased rapidly. Teaching large courses in a computer science department presents a unique set of challenges. These courses often attract hundreds of students, all with diverse skill levels, learning styles, and expectations. While the prospect of shaping so many young minds is exciting, the reality is that limited teaching assistant (TA) support and resources impose constraints on what is feasible. Often, universities put pressure on the departments to increase the number of seats in the courses without augmenting the requisite infrastructure and manpower. Over the years, I have navigated this landscape, learning to strike a balance between the ideal course I envision and the practical realities of teaching at scale. This article reflects on my experiences and lessons learned in managing this trade-off.

1 The Vision vs. The Reality

When I design a course, I aim to make it engaging, interactive, and deeply educational. I imagine students actively participating in discussions, working on creative projects, and receiving personalised feedback that helps them grow. However, the reality of teaching large classes is far more complex. With hundreds of students and limited TA support, implementing these ideals becomes a daunting task. The challenge lies in deciding what to prioritise: depth of learning, breadth of topics, or the scalability of assignments and assessments.

Adding to this complexity is the fact that at my university, student attendance is not mandatory, and lectures for large courses are recorded and made available online for students to access at their convenience. While this policy promotes flexibility, it also reduces direct interaction with students, making it more challenging to foster engagement and maintain a classroom community.

2. Key Challenges in Large Classes

2.1 Designing Challenging Assignments

Creating programming assignments and projects that are both engaging and educational is a major challenge. These tasks require careful design to ensure they are neither too trivial nor overly complex. However, the time and effort needed to evaluate such assignments can be overwhelming, especially with limited TA support. Balancing the desire to include creative, open-ended tasks with the practicalities of large-scale evaluation is an ongoing struggle. Often, I have had to forego my intention of giving the students engaging and challenging assignments because of the large class sizes. Does it do injustice to students? I believe it does, but often we are left with very little options given the pressure on the faculty to perform in different other areas like research and administrative duties.

2.2 Grading and Feedback

One of the most significant challenges is providing timely and meaningful feedback. Given the large size of the classes, we often have to rely on automated grading tools, at the cost of the feedback being impersonal and probably not helping the student as much in improving their methods and processes. Automated grading tools cannot replicate the nuanced feedback a TA or instructor can provide. When students submit hundreds of assignments, even managing auto-grading systems becomes a logistical challenge.

Again, owning to the large classes, in the examinations, an instructor is forced to design questions which can be evaluated by unskilled TAs in a few days. The TAs often fumble when the questions involve thinking and deep understanding of concepts. This rules out including challenging design questions in the exams, and only allows the instructors to set questions with set and known solutions.

Another consequence of the large courses is the rising use of unfair means in evaluative components. Given the very competitive landscape in computer science, students often resort to using unfair means in completing their assignments as grades and GPAs determine several aspects of their future. This defeats the design of the teaching and learning model and is also unfair for students who put in honest effort into a course.

2.3 Student Engagement

Maintaining engagement in a large lecture hall is another hurdle. While smaller classes allow for discussions and active participation, large classes often feel impersonal, making it easier for students to disengage. The availability of recorded lectures further complicates this, as students may opt to watch the material at their own pace, reducing opportunities for real-time interaction. The declining student engagement further demotivate the instructor from putting in efforts to design an engaging class. There has been some debate that a more engaging class would bring more students to the class, but through experience and through discussions with a few of my colleagues, I have learnt that this is not always true, given the race after grades and GPAs at the cost of learning.

2.4 Administrative Overheads

Managing a large course involves a significant amount of administrative work, from organising exams to addressing individual student concerns. Without adequate support, these tasks can consume time that could be better spent on improving the course content.

3 Strategies for Success

Through trial and error, I have developed several strategies to address these challenges. However, these strategies are not a substitute for direct engagement with students in small classroom settings.

3.1 Leveraging Technology

Technology has been a great help in managing large courses. Learning management systems (LMS) streamline communication, while tools like auto-graders and plagiarism detectors reduce the burden of grading. For example, I have used platforms like Moodle Virtual Programming Labs to manage coding assignments efficiently, enabling students to submit, test, and iterate on their work. I have also used plugins on Moodle to design multiple choice question for OMR sheets which can be evaluated quickly using a simple scanner.

3.2 Prioritising Core Objectives

In a large course, it is crucial to focus on the core learning objectives. While I may want to include exciting, open-ended projects, I often scale these down to simpler assignments that still achieve the desired outcomes. This compromise ensures that students learn the fundamentals without overloading the limited resources available.

3.3 Encouraging Peer Learning

Peer learning can be a powerful tool in large classes. I encourage students to participate in online forums where they can help each other. I have also experimented with peer review of assignments and projects. Structured peer reviews for assignments not only reduce grading pressure but also reinforce learning by teaching.

3.4 Efficient Use of Office Hours

With hundreds of students, one-on-one office hours are impractical. Instead, I use online Q&A for a to address common concerns. Tools like Piazza enable students to ask and answer questions collaboratively, creating a supportive learning environment.

4 Reflecting on the Trade-offs

Teaching large courses often feels like walking a tightrope. Every decision— whether to simplify an assignment, use an automated tool, or limit personal interactions—involves trade-offs. The availability of recorded lectures and flexible attendance policies adds another layer to this balancing act. Over time, I have come to accept that perfection is unattainable in such settings. Instead, I focus on delivering a course that is effective, equitable, and sustainable.

5 What Institutions Can Do

While strategies help mitigate challenges, there are broader solutions that institutions and educators can explore to better support large courses. Institutions should be more open to innovations in teaching and assessment methods.

5.1 Investing in Faculty and TA Support

Universities should consider hiring more faculty members to ensure a better instructor-to-student ratio. This would allow for more manageable class sizes and provide students with greater access to personalised instruction. Additionally, increasing skilled TA allocations for large courses is crucial. More TAs mean better support for grading, personalised feedback, and administrative tasks. Providing structured training programmes for TAs can further enhance their effectiveness in assisting both instructors and students.

5.2 Developing Scalable Assessment Methods

Adopting more scalable assessment techniques can alleviate the burden of evaluating complex assignments. For instance, using tiered auto-grading systems or focusing on project-based assessments with well-defined rubrics can help manage workloads while maintaining quality.

5.3 Incorporating Gamification and Interactive Platforms

Engagement can be boosted by incorporating gamification elements into coursework, such as leader-boards, badges, or coding challenges. Interactive platforms that allow students to solve problems collaboratively can also create a more engaging learning experience.

5.4 Leveraging AI and Advanced Tools

AI-powered tools can assist with tasks like grading, plagiarism detection, and even personalised feedback. For example, AI chatbots can answer frequently asked questions, freeing up instructors' time to focus on teaching.

5.5 Creating Communities of Practice

Encouraging instructors teaching large courses to share resources, experiences, and strategies can foster innovation and reduce duplication of effort. A community of practice could also help standardise best practices for managing large classes.

6 Looking Ahead

As computer science education continues to grow in demand, the challenges of teaching large courses will only intensify. Institutions must invest in infrastructure and support systems to help instructors manage these demands. In the meantime, sharing experiences and strategies within the teaching community can help us all navigate the complexities of large-scale education.

Teaching large courses has taught me resilience, adaptability, and the value of collaboration. While it may not always be easy, the impact of reaching so many students does make the effort worthwhile.

“THE INFLUENCE OF PERSONALITY TRAITS OF STUDENTS ON LEARNING OUTCOMES”

–Prof. Kirtimaan Syal, GEMM Laboratory, Department of Biological Sciences

Introduction

Personality is defined as a combination of characteristics and set of attributes that manifest in various situations and distinguishes one individual from another. The growing interest in studying personality traits in this technology-driven era has led researchers and practitioners to adopt the Five-Factor Personality Model (FFM) introduced by psychologists Digman and Goldberg. As per the model, the personality can be defined in terms of traits such as extraversion, agreeableness, emotional stability, conscientiousness, and openness to experience. The Big Five personality traits play a crucial role in predicting metacognitive knowledge and learning ability under different situations. Evidently, individual’s personality traits influence the strategies and methods they use to learn, including the time and motivation dedicated to the process (Komarraju et al., 2011). These traits also serve as key predictors for regulating knowledge, significantly impacting the evaluation of cognitive processes.

An individual's dominant personality traits greatly shape how they assess their learning efficiency. Individual learning styles evolve based on personal characteristics, and an effective learning style can empower students to excel academically in any subject they pursue. Personality traits play a crucial role in achieving learning goals and outcomes which influence students' learning styles and behaviors (Komarraju et al., 2011). Therefore, understanding the relationship between personality traits and learning styles is essential for optimizing learning.

Five-Factor Model

Within the Five-Factor Model, the individual traits may act as key factors that may impact academic performance in the given environment, for example, agreeableness encompasses humane attributes such as altruism, compassion, emotional and social support, in contrast to the traits like hostility, indifference, jealousy, and spitefulness. Agreeable individuals tend to be cooperative and-

less quarrelsome compared to their disagreeable counterparts. Conscientiousness represents a core personality attribute characterized by responsibility, organization, diligence, goal orientation, and adherence to rules and conventions. Highly conscientious individuals exhibit strong self-discipline, preferring structured plans over impulsive actions. Their methodical preparation and commitment often contribute to success in their pursuits (Roberts et al., 2014). Extraversion is a personality trait that reflects variations in social behavior, assertiveness, emotional regulation, approach tendencies, and a drive for status, representing a higher-order dimension of personality differences. Emotional stability refers to resilience against negative emotional responses such as fear, anger, impatience, or guilt. It signifies an individual's ability to maintain balance and competence when facing challenges, demonstrating strength and capability. Openness to experience is often associated with open-mindedness which describes individuals who are curious, creative, and innovative. This trait is linked to a desire for novel and enriching life experiences, cognitive curiosity, and a tolerance for new ideas (DeYoung et al., 2014). It is strongly associated with divergent thinking and creativity.

Learning Styles

Learning styles are defined as a combination of cognitive, affective, and psychosocial activities that consistently influence how students perceive, engage with, and respond to their learning environment (Romanelli et al., 2009). Understanding learning styles is crucial for effective education, as it enables students to develop a deeper comprehension of the subject matter. While no universally accepted framework for learning styles exists, various scales and models are widely used. Both instructors and students benefit from recognizing and adapting to students' learning styles.

Students who understand their own learning preferences can adopt diverse strategies to enhance their learning experiences, leading to improved satisfaction and educational outcomes. Learning styles encompass various strategies, including superficial or deep information processing, holistic or sequential knowledge processing, detailed analysis, retention, and systematic recall of information. These diverse styles influence how individuals approach learning across different subjects.

The effectiveness of learning-style-based methods in enhancing both learning and instruction explains their widespread popularity. Learning styles describe how individuals process external information, personal knowledge, and experiences. This processing can be active involving physical activities or discussions OR reflective where individuals engage in introspection. Active learners prefer experimenting and discussing knowledge to solidify understanding, while reflective learners focus on thoughtful analysis and comprehension before taking action.

A student's inclination towards sensing or intuitive learning also varies. Sensing learners thrive on practical, tried-and-true methods, favoring detailed information and avoiding complexity. Intuitive learners, on the other hand, excel in identifying patterns, exploring possibilities, and welcoming innovation, while often disliking repetition. Effective learners and problem solvers are adaptable, balancing both approaches. Learning styles also play a critical role in how students acquire, retain, and process knowledge. For example, sequential learners prefer step-by-step organization of information and excel when material is presented in a linear, chronological format. This enhances their logical thinking. In contrast, global learners approach learning holistically, valuing interpersonal connections and taking time to understand concepts deeply. They often respond emotionally to learning and excel through stories and anecdotes, demonstrating an ability to anticipate outcomes.

Together, learning styles are pivotal in shaping students' active learning and problem solving abilities, highlighting the need for tailored educational approaches.

The four dimensions of learning styles that represent learning preferences are Active vs. Reflective Learners, Sensing vs. Intuitive Learners, Visual vs. Verbal Learners, and Sequential vs. Global Learners. Each individual tends to favor one or more of these styles. On one side, active learners thrive by engaging directly with learning material, applying concepts, and experimenting with new ideas and on the other hand, reflective learners, in contrast, prefer to think deeply and analyze what they are learning before taking action.

Sensing learners are drawn to facts and concrete information, preferring to solve problems using established methods. They are detail-oriented and comfortable with structured, practical material. On the other hand, intuitive learners incline towards abstract concepts and theories, excelling at identifying patterns and exploring possibilities. They are often more creative and innovative than sensing learners.

The visual-verbal dimension distinguishes between learners who retain information better through images, diagrams, and visual representations, and those who benefit more from text, whether written or spoken.

Sequential learners prefer a step-by-step approach, progressing logically and incrementally to build understanding. In contrast, global learners adopt a holistic perspective, learning in leaps and focusing on the big picture. They often rely on intuition and make connections that may not be immediately apparent, using stories or context to process information effectively.

These learning patterns suggest the diverse ways individuals process and engage with knowledge, emphasizing the importance of personalized learning approaches.

Learning Competencies

Learning competencies refer to the essential knowledge, skills, and abilities that students are expected to acquire. They serve as a measure of an individual's capacity to apply newly learned skills and knowledge to complete learning tasks. These competencies are crucial for ensuring that students are prepared to navigate evolving societal and educational contexts. The development of lifelong learning competencies is especially important as it shapes the workforce and influences societal values and attitudes toward sustainable development, with educational institutions playing a key role in this process (Quendler and Lamb, 2016).

The learning competencies in domain-specific subjects takes into account the unique abilities and needs of the learner. It presents an innovative approach to enhancing student performance, ensuring that each individual reaches their full potential and has a successful learning experience. Learning competencies emphasize that meaningful outcomes are only realized when the required competencies to learn a topic, subject, or concept are fully attained.

Discussion

The process of developing competence involves a deeper engagement with the material being studied, moving beyond surface-level understanding to explore its structure, context, and underlying assumptions. This critical approach not only enhances mastery of the content but also fosters a more profound comprehension of the norms and societal expectations that shape how individuals think, feel, and behave in the learning process. By engaging closely with the material, students are better equipped to understand the broader societal and cognitive frameworks that influence their learning, which is a crucial step in becoming more self-aware and continuously improve in their educational journey.

Behavioral competencies, such as learning goals, learning strategies, and collaboration, also play a significant role in fostering student flexibility and self-organization. When students are able to effectively manage their learning processes—whether through choosing the right techniques, adapting to new situations, or collaborating with peers—they may become self sufficient learners. This self-organization is a critical skill for lifelong learning, as it enables students to navigate diverse learning environments and challenges with confidence.

Learning to develop competence requires students to engage in reflective thinking about their assumptions and biases, challenging preconceived notions about the content they are studying and the ways in which they approach learning. This reflection is essential for cultivating critical thinking skills, as students begin to question not only the material at hand but also their cognitive processes and learning behaviors. It encourages students to move beyond passive absorption of information to active, intentional learning, where they can apply new knowledge in meaningful ways. Furthermore, the development of competence is closely linked to motivation for learning. Students who are motivated to learn are more likely to engage in behaviors that promote competence development, such as setting specific learning goals, selecting appropriate learning methods, and collaborating with others. Motivation serves as a catalyst for these behaviors, driving students to seek out the necessary resources and opportunities to deepen their understanding. The ability to align one's learning goals with personal interests and motivations enhances engagement, making the learning process more meaningful and rewarding.

Together, the process of developing competence is not just about acquiring knowledge but also about understanding and adapting to the cognitive, emotional, and social dimensions of learning. The students can enhance their behavioral competencies and become more adaptable and self-organized in their learning endeavors by fostering a deeper understanding of content, refining learning strategies, and promoting motivation and collaboration. This holistic approach not only contributes to academic success but also prepares students for the complexities and challenges they will face in both their professional and personal lives.

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HOW TO BALANCE RESEARCH AND TEACHING?

–Prof. Nikumani Choudhury, Department of Computer Science and Information Systems

Balancing research and teaching is a perennial challenge faced by educators and researchers in academic institutions worldwide. Both endeavours demand a significant investment of time, energy, and creativity, yet striking a balance between them is crucial for personal fulfilment, professional growth, and the holistic development of students. Research and teaching are often perceived as competing priorities. Research involves generating new knowledge, pushing the boundaries of a discipline, and contributing to scholarly conversations. Teaching, on the other hand, is cantered on imparting knowledge, mentoring students, and fostering their intellectual growth. While these roles may seem divergent, they are deeply interconnected. Effective teaching often relies on up-to-date research, while research can be enriched by the insights and questions arising from teaching.

Balancing lecture preparation, grading, mentoring students, and conducting research within the constraints of a 24-hour day is a daunting task. Institutions often emphasize one role over the other, with research-focused universities prioritizing publications and grants, while teaching-intensive institutions value classroom performance. For an university like BITS Pilani, where there is an equal weightage for teaching and research, it becomes more challenging to find the right balance between the both. Faculty members must adopt unique strategies to balance the dual responsibilities effectively.

Limited access to research funding, laboratory facilities, or teaching assistants can exacerbate the tension between research and teaching duties. Overcommitting to either teaching or research can lead to burnout, diminishing effectiveness in both areas. While excelling in research requires analytical and investigative skills, teaching demands communication, empathy, and adaptability. Balancing these skillsets can be challenging. Time management and prioritization are key to balancing research and teaching. Using structured scheduling techniques such as time-blocking can help allocate specific hours for research, teaching, and administrative tasks, with uninterrupted periods dedicated to high-priority activities like manuscript writing or lecture preparation. Setting clear goals for both research and teaching and breaking these objectives into manageable tasks can enhance productivity. It is also essential to learn to say no to commitments that detract from core responsibilities.

Integrating research and teaching can create a synergistic relationship between the two. Research-informed teaching involves designing courses and assignments that incorporate recent findings, enriching student learning while deepening your understanding of your research topic. Engaging students in our research project courses (LoP, DoP, SoP) through undergraduate research opportunities, thesis supervision, or collaborative publications benefits students while providing additional perspectives for your work.

Further, developing courses that align with your research interests enables a seamless integration of teaching and research. Collaboration and delegation are essential strategies for managing workload effectively. Collaborative research with colleagues can lead to diverse perspectives and more robust findings. Delegating some responsibilities like lab or tutorial sessions to teaching assistants can free up time for research, especially in large courses of CSIS and EEE. Additionally, creating competitive in-class fellowships or internships that incentivize students to assist in your research, providing hands-on experience while advancing your work. For instance, around 10 students in CSIS/EEE were supported (Rs 10,000 pm) in the last 18 months through external funded projects to conduct research and get hands-on experience with hardware and prototype development. The recent idea to use AR/VR/XR in few course module is an interesting idea towards the direction of managing teaching with research by BITS Pilani. Developing gamified modules that incorporate your research findings, making lectures interactive and reinforcing your research themes in an engaging way. Further, there is a greater need to encourage students to produce publishable work in bite-sized portions, allowing them to co-author papers while gaining academic exposure.

Professional development is an essential component of academic growth, particularly for individuals involved in both teaching and research. The ability to balance these two key responsibilities can be challenging, but the benefits of effectively managing both roles are significant, not only for personal career development but also for the broader academic community. Engaging in professional development opportunities can help enhance skills in both domains, making the balance between teaching and research more achievable and rewarding.

Attending workshops or training sessions focused on effective teaching strategies or research methodologies can be incredibly valuable for academics seeking to improve their skills. For teaching, workshops on pedagogical approaches, active learning, and student engagement strategies can provide fresh ideas for making lectures more interactive and impactful. Educators who keep up with new teaching methodologies can implement evidence-based practices in their classrooms, thereby improving student learning outcomes. Additionally, these workshops can provide a space for academics to discuss challenges with peers and gain insights into how others approach teaching, which fosters a sense of community and shared learning. On the research side, attending workshops on advanced research methodologies, grant writing, or data analysis tools can help academics refine their research approaches. Specialized training in emerging fields, such as AI or machine learning, can also provide cutting-edge insights and techniques, enhancing the researcher's ability to explore new areas and contribute to advancements in their field. These professional development activities not only build technical skills but also expand an academic's network, as they often provide opportunities to collaborate with peers from other institutions or fields.

Seeking mentorship from experienced colleagues who have successfully navigated the balancing act between teaching and research is another powerful strategy for professional development. They can provide valuable guidance by sharing their own experiences and offering practical advice on how to effectively juggle both responsibilities. She/He can help identify which aspects of teaching and research need more focus at different times and offer strategies to maximize productivity and satisfaction in both areas. Moreover, they can provide insights into how to approach career development, secure funding, and build a robust academic portfolio.

Networking with other academics at conferences, seminars, or online platforms can also offer valuable support. Through these interactions, individuals can share best practices, discuss challenges, and collaborate on interdisciplinary projects. These connections not only foster professional growth but can also lead to new opportunities for research partnerships, guest lectures, or collaborative teaching ventures. While professional development is crucial, it is equally important to prioritize self-care and work-life balance. The pressure to excel in both teaching and research can often lead to burnout if not managed properly. Therefore, it is vital for academics to create time for activities that promote their well-being, such as regular exercise, mindfulness, hobbies, and social interactions outside of work. Physical and mental health have a direct impact on productivity, creativity, and job satisfaction. When academics are well-rested and mentally rejuvenated, they are more likely to be effective in both the classroom and the research lab. Scheduling regular breaks throughout the workday, setting aside time for weekends, and taking full advantage of vacations or sabbaticals can help prevent fatigue and enhance long-term career sustainability.

Balancing teaching and research can have profound advantages, both personally and professionally. For one, research-informed teaching exposes students to the latest developments in a particular field, encouraging them to engage critically with the subject matter.

Students benefit from exposure to cutting-edge knowledge, which enhances their academic experience and prepares them for future careers. By integrating research into their teaching, academics not only inspire their students but also reinforce their own understanding of the material, as teaching often requires a deeper level of mastery. Moreover, the act of balancing these roles fosters versatility. Academics who engage in both teaching and research develop a range of skills that make them more adaptable to diverse environments, both within and outside academia. They become experts in time management, communication, and problem-solving—skills that are invaluable in any professional setting. This versatility can lead to greater career opportunities, including leadership roles, speaking engagements, or administrative positions within academic institutions. The synergy between research and teaching can also lead to enhanced productivity. Teaching often sparks new ideas for research, while research can inform more dynamic, real-world examples in the classroom. For instance, an academic might conduct research on emerging technologies, then incorporate those findings into classroom discussions, creating a richer learning experience for students. Similarly, student feedback can help refine research questions and methodologies, as they bring fresh perspectives to complex topics.

In computer science, for instance, Prof. XYZ specializes in Cyber security research. She/He teaches a course on Network Security for FD/HD. The Prof. may assign to analyse specific encryption algorithms to the students as a part of project. Class assignments can be used to refine ongoing research, such as testing intrusion detection system. As an outcome, students get hands-on research experience, and she receives valuable feedback and data points for her research. Another Prof. ABC, specializing on reinforcement learning for autonomous systems while teaching AI course develops AI models as part of his research and uses them as examples in his lectures. The Prof. encourages students to replicate portions of his experiments as part of term projects and provides opportunities for high-performing students to intern in his research lab, enabling them to co-author research papers.

Also, academic institutions play a critical role in helping faculty balance these responsibilities. Implementing fair workload distribution policies ensures that faculty members can dedicate adequate time to both research and teaching. Providing research grants (NFSG, CDRF), teaching assistants, and access to state-of-the-art facilities can alleviate resource constraints. Acknowledging and rewarding efforts to integrate research and teaching fosters a culture that values both roles equally. Offering workshops, sabbaticals, and mentoring programs helps faculty enhance their skills and achieve balance. Balancing research and teaching is not a one-size-fits-all endeavour. It requires intentional planning, adaptability, and a commitment to both personal growth and the success of students. By integrating research and teaching, leveraging institutional support, and prioritizing self-care, academics can navigate these dual responsibilities effectively. Ultimately, a harmonious balance between research and teaching enriches the academic experience for both educators and students, fostering a thriving academic community.

HOW TO PROMOTE A SCIENTIFIC TEMPER?

– Prof. Nitish Kumar Gupta, Department of Electrical and Electronics Engineering

Sometime back, when I joined the BITS Pilani and stepped into the bustling corridors of the Hyderabad Campus, I was filled with a mix of excitement and apprehension. The energy of young minds eager to achieve great things was palpable and thrilling, yet (to some extent) I was aware of the challenge that lay ahead! Which is to keep the quest for scientific inquiry and research active, thriving, and burgeoning, given the vibrant and demanding teaching landscape, which is always ready to consume one's attention.

Amidst these thoughts I was naturally looking for some comforting advice, but instead I was struck by a curious realization: It may so happen that some of the students, in all their generosity, would like to acquire some skills and temperament from you. Such a prospect dumps upon a big responsibility as you seem to become more than a stakeholder in their future. As the thought sinks in, invariably, you would like to make conscious efforts to equip them with the needed temperament and spirit. But that's where the conundrum unfolds: First of all, how to make sure that you impart all the 'right' ingredients to the students when the recipe itself feels a bit... empirical at times?

The most crucial ingredient in this recipe? A scientific temper! Secondly, even if you discover some magic wand to figure out the right mix, you cannot forget that you are not the protagonists in this act. Your role is limited to being a facilitator only! Ultimately, it's the student who must make genuine efforts to acquire the 'right' ingredients. Already sounds hopeless and helpless, right? But given the uniqueness of teacher–student relationship you don't want to give up on pushing for the 'right' things? Dealing with this on a continued basis is a challenge in itself, and the sad part is there are no, milestones down this road!

While I was feeling high with all these 'noble' thoughts, the mind tricked me into its own battles. It sent me down a minor philosophical rabbit hole. "How did I cultivate my scientific temper?" Or even worse, "Do I even possess one?" Thankfully, I managed to emerge relatively unscathed, reassuring myself that, yes, a scientific temper is indeed present. As deviated as it may sound, this sojourn did serve the purpose of making me aware of a significant lack of discourse and the glaring apathy towards inculcating scientific temper. In the backdrop of all this introspective chaos, this article is a humble attempt in search for a streamlined thought process in the context of scientific temper.

Time to change gears and move beyond these frolicsome reflections. At the very outset, let's wholeheartedly acknowledge the fact that cultivation of scientific temper is not merely an aspirational goal or a 'noble pursuit'; it is a national imperative. Knowing well the urgency and complexity of this endeavour, the rest of the article is written in all its seriousness to help beginners who often struggle to stay afloat in these troubled waters.

Defining Scientific Temper: An immediate impasse

Scientific temper is not a monolithic concept; it encompasses a constellation of intellectual attributes and dispositions that are essential for navigating the complexities of the modern world. While Jawaharlal Nehru's articulation of scientific temper in The Discovery of India (1946) provides a first-hand introduction, contemporary research has further enriched our understanding of this complex construct. A scientific temper, as described by Nehru, involves "the search for truth and new knowledge, the refusal to accept anything without testing and trial, the capacity to change previous conclusions in the face of new evidence, the reliance on observed fact and not on preconceived theory". Notice here that Scientific Temper is different from the act of merely possessing scientific knowledge; it is a way of life that embraces critical thinking, scepticism, and a constant pursuit of knowledge. It requires moving beyond the traditional confines of rote learning and embracing a pedagogical approach that nurtures critical thinking, encourages intellectual curiosity, and fosters a spirit of inquiry. This necessitates a shift from passive absorption of information to active engagement with knowledge, where students are empowered to question, analyse, and evaluate information critically. Cultivating this scientific temper is crucial, as it empowers citizens to become active participants in the nation-building process.

Key Dimensions of Scientific Temper:

- **Critical Thinking:** Critical thinking lies at the heart of scientific temper. It involves the ability to analyse information objectively, identify underlying assumptions and biases, evaluate evidence rigorously, and form independent judgments (Facione, 2011). Halpern (2014) emphasizes the importance of metacognitive skills in critical thinking, highlighting the need for individuals to be aware of their own thinking processes and to actively monitor and regulate their learning. I cannot emphasize more my personal observation that critical thinking is not merely a skill; it is a habit of mind that requires continuous cultivation and practice.
- **Scepticism:** A healthy dose of scepticism is crucial for scientific inquiry. It entails questioning established ideas, demanding evidence, and ensures openness to the possibility of being wrong (Sagan, 1995). Merton (1973) argues that organized scepticism is a core norm of science, ensuring that claims are subjected to rigorous scrutiny and that knowledge is constantly refined and updated. Notice that scepticism is not about cynicism or denial; it is about approaching claims with a discerning eye and seeking robust evidence before accepting them as truth.
- **Open-mindedness:** Open-mindedness involves being receptive to new ideas, alternative perspectives, and the possibility of revising one's beliefs in the face of compelling evidence (Dweck, 2006). It requires a willingness to challenge one's own preconceptions and to embrace the dynamic nature of scientific understanding. Kuhn (1962) argues that scientific progress often involves paradigm shifts, where existing theories are replaced by new ones that better explain the available evidence. Open-mindedness is essential for navigating these tectonic shifts and embracing new ways of understanding the world.

- **Evidence-based Reasoning:** Evidence-based reasoning is the cornerstone of scientific inquiry. It involves drawing conclusions based on observation, experimentation, and logical inference, rather than solely relying on anecdotes, or authority (National Research Council, 2000). Toulmin (1958) provides a framework for analysing arguments, emphasizing the importance of providing evidence and warrants to support claims. An important caveat here: Evidence-based reasoning is not just about collecting data; it is about critically evaluating the quality of evidence and using it to draw logical conclusions.
- **Creativity and Imagination:** Scientific temper is not confined to rigid analysis; it also fosters creativity and imagination (Root-Bernstein, 2003). Here it is opportune to quote Einstein who famously said, "Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand." So, creativity and imagination are essential for generating new ideas, formulating hypotheses, designing experiments, and interpreting data. It allows scientists to push the boundaries of knowledge and explore uncharted territories.
- **Ethical Conduct:** Scientific temper extends beyond the pursuit of knowledge; it encompasses a commitment to ethical practices, integrity, honesty, and objectivity in research and academic pursuits (National Academy of Sciences, 1995) Resnik (2015) emphasizes the importance of responsible conduct in research, including adherence to ethical guidelines, protection of human subjects, and responsible use of research funds.

These dimensions of scientific temper are not mutually exclusive; they are interconnected and mutually reinforcing. Hence, cultivating scientific temper requires a holistic approach that addresses all these dimensions. This can be highlighted well with a flow chart as depicted in Fig.1..

Challenges and Opportunities in Indian Higher Education System

India faces a unique set of challenges and opportunities in its quest to foster scientific temper within its higher education institutions. While the nation features a rich scientific heritage and a growing pool of talented students and researchers, several factors hinder the widespread cultivation of scientific temper.

Key Challenges:

- **Rote Learning and Exam-centric Culture:** The traditional emphasis on rote learning and memorization in Indian education often comes at the expense of critical thinking and inquiry (Kumar, 2011). The pressure to perform well in examinations can lead to a focus on memorizing facts and formulas rather than developing a deep understanding of concepts and engaging in critical analysis. This exam-centric culture can stifle creativity, discourage questioning, and hinder the development of scientific temper.
- **Inadequate Infrastructure and Resources:** Many higher education institutions (HEIs) in India face challenges related to inadequate infrastructure and resources, including limited access to well-equipped laboratories, libraries, and technology (AICTE Annual Report, 2021). This can hinder the implementation of inquiry-based learning, research-based activities, and other pedagogical approaches that promote scientific temper. Equitable distribution of resources is crucial to ensure that students from all backgrounds can engage in hands-on learning and scientific inquiry.

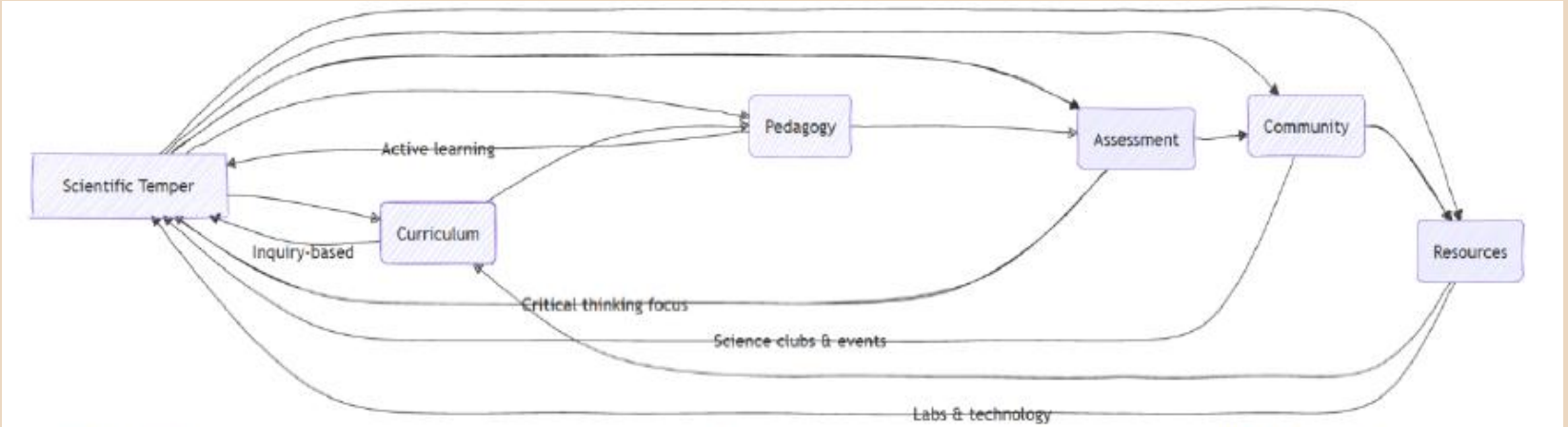

Fig.1: Flowchart depicting the interconnected of various elements that can contribute to a thriving scientific culture (generated using Mermaid Live Editor).

- **Faculty Development and Training:** Equipping faculty members with the pedagogical skills and knowledge to effectively foster scientific temper is essential. This requires investing in high-quality faculty development programs that focus on inquiry-based learning, active learning strategies, and the integration of technology into teaching. Faculty members need to be empowered to create engaging learning environments that stimulate curiosity, encourage questioning, and promote critical thinking.
- **Large Class Sizes:** Large class sizes in many Indian HEIs can make it challenging to implement active learning strategies and provide individualized attention to students. This requires development of altogether new teaching strategies to engage large classes effectively. This is easier said than done, which often leaves us with the only option of investing more and more into the resources.
- **Lack of Awareness of Scientific Conduct:** There is a lack of awareness among students and faculty about the rules and standards of proper scientific conduct. This can lead to plagiarism and other forms of scientific misconduct, which not only undermines the integrity of research but also hinders the development of scientific temper by discouraging ethical behaviour and intellectual honesty.

Opportunities:

N**ational Education Policy 2020:** The National Education Policy 2020 (NEP 2020) provides a transformative framework for Indian education, with a clear emphasis on fostering scientific temper and critical thinking (Ministry of Education, 2020)14. NEP 2020 emphasizes experiential learning, interdisciplinary approaches, integration of Indian Knowledge Systems (IKS), and a focus on foundational literacy and numeracy. It also calls for a shift from rote learning to competency-based education, with a focus on developing critical thinking, problem-solving, and communication skills. Out of the rainbow of topics that it covers I specifically touch upon the two most pertinent ones:

- **Interdisciplinary Approach:** Promotes the integration of science with other disciplines to foster holistic understanding and address complex problems from multiple perspectives. This involves breaking down traditional disciplinary boundaries and encouraging students to explore connections between different fields.

- **Teacher Training:** Emphasizes the role of educators in fostering scientific temper among students through effective pedagogy and mentorship. This includes providing teachers with professional development opportunities to enhance their teaching skills and knowledge of scientific temper.

Overall, the NEP 2020 offers a transformative vision for Indian education, with a strong emphasis on cultivating scientific temper, provided it is implemented effectively and with fidelity to its core principles.

Growing Research Ecosystem: India's research ecosystem is rapidly expanding, with increased investment in research and development, establishment of new research institutions, and growing international collaborations. This provides opportunities for students to engage in multi-faceted research experiences and interact with leading researchers, which is probably the most organic way of fostering scientific temper.

Technological Advancements: Rapid advancements in technology, including the proliferation of digital tools and online resources, offer new opportunities for promoting scientific temper.

Science Communication and Outreach: Effective science communication and outreach initiatives can play a vital role in promoting scientific literacy and fostering scientific temper within both educational institutions and the broader society. Science festivals, public lectures, science cafes etc provide an easy opportunity for the beginners to indulge with science, demystify scientific concepts, and cultivate a culture of scientific inquiry.

A SWOT analysis can effectively synthesize and present this information, making it easier to grasp the key takeaways.

Fig.2: SWOT analysis infographics for the challenges and opportunities associated with the scientific temper in Indian Higher Education System.

A Framework for Fostering Scientific Temper

Promoting scientific temper in Indian higher education requires a multi-pronged approach that encompasses curriculum design, pedagogy, assessment, research, and the creation of a vibrant scientific culture. Here I list out a probable roadmap for fostering scientific temper within universities and research institutions:

1. **Evidence-based Curriculum Design:**
    - **Incorporate Inquiry-Based Learning:** Inquiry-based learning should be integrated into the curriculum across disciplines, providing students with opportunities to formulate research questions, design experiments, analyse data, and draw conclusions. This can be achieved through project-based learning, research-based assignments, case studies, open-ended problems, and problem-based learning scenarios.
    - **Promote Interdisciplinary Thinking:** Encourage students to explore the interconnectedness of different disciplines and apply scientific thinking to various fields. This can be achieved through interdisciplinary courses, collaborative projects, and team-based learning activities.
    - **Incorporate History and Philosophy of Science**: Introducing students to the history and philosophy of science can provide context, inspire critical thinking, and foster a deeper understanding of the scientific process. To this objective, we can rely upon dedicated courses, lectures, and readings that explore the evolution of scientific thought, the nature of scientific knowledge, and the ethical dimensions of science.
    - **Emphasize Ethical Considerations:** Integrate discussions on ethical issues related to scientific research and technological advancements into the curriculum. These considerations can be imparted through case studies, debates, and role-playing exercises that explore ethical dilemmas in science and encourage students to develop a strong ethical compass.

2. **Active Learning Pedagogy:**
    - **Something beyond Lectures:** While lectures are effective means of conveying information, they should be complemented with active learning strategies that promote student engagement and critical thinking. This includes discussions, debates, collaborative projects, peer teaching, problem-solving activities, and simulations.
    - **Effectively Utilization of Technology:** Integrate technology into teaching to enhance learning experiences, provide access to a wider range of resources, and promote collaboration. This includes using online simulations, virtual labs, interactive learning platforms, educational software, and online databases. However, it is crucial to use technology thoughtfully and ensure that it complements rather than replaces hands-on learning and face-to-face interactions.
    - **Encourage Research and Inquiry:** Provide opportunities for undergraduate research experiences, internships, and mentorship programs to cultivate a spirit of inquiry, develop research skills, and inspire students to pursue careers in science. This can also involve incorporating research components into coursework, such as mini-research projects, literature reviews, and data analysis activities. Specifically, a strong emphasis on interdisciplinary research is the most opportune thing to begin with.

The above-mentioned points have been categorized and depicted in Fig.3 as a flow chart for ease of comprehension.

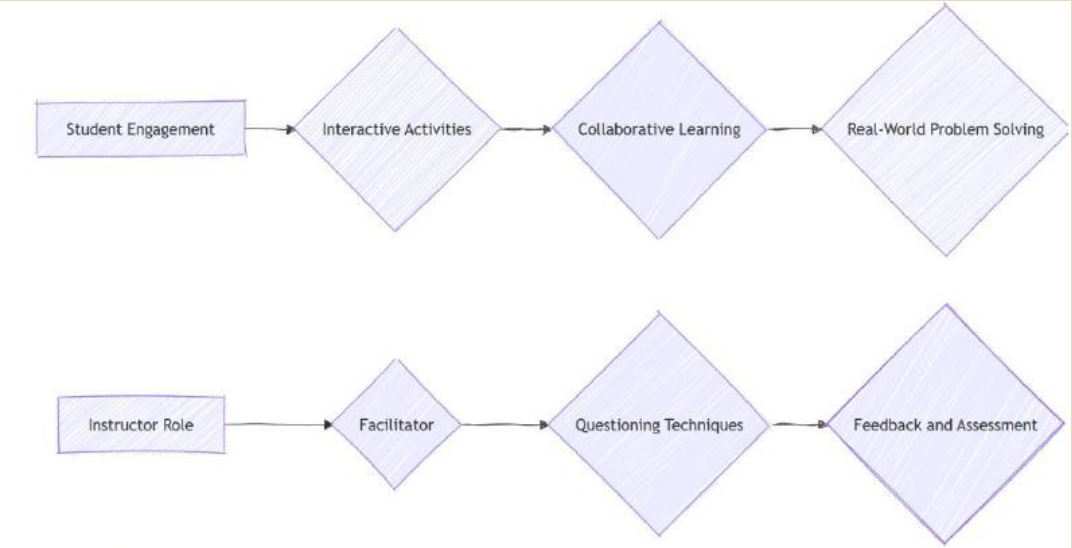

Fig.3: Key Components of Active Learning (generated using Mermaid Live Editor).

3. Establishing a Culture of Science:

- **Science Communication and Promotion:** We need to encourage students to engage in science communication activities, such as presentations, science writing workshops, participation in science festivals and outreach programs, and if possible, motivate them for writing publications. This can help them develop their communication skills, share their knowledge with a wider audience, and contribute to public understanding of science.
- Organize Science Events: This includes hosting science fairs, workshops, guest lectures, seminars, and conferences to stimulate interest in science, provide opportunities for interaction with experts, and foster a sense of community.
- **Establishment of Science Clubs and Societies:** Support the establishment of student-led science clubs and societies that provide platforms for students to explore their scientific interests outside the classroom, engage in peer learning, and organize science-related activities.
- **Celebrate Scientific Achievements:** We must recognize and celebrate the achievements of students and faculty in scientific research and innovation to inspire others and foster a culture of excellence. This creates a positive and supportive environment for scientific pursuits.
- **Foster Mentorship and Role Models:** We should try connecting students with mentors and role models in the scientific community, including faculty members, researchers, and industry professionals, to provide guidance, inspiration, and support. We can also leverage technology to facilitate collaborative research projects and connect students with scientists and experts from around the world, expanding their learning opportunities and networks.

4. **Reimagining the Process of Assessment:**
    - **Shifting Focus from Exams to a Holistic Assessment:** We should start thinking of moving away from traditional exam-centric assessments that primarily test memorization & recall and try to design assessments that evaluate critical thinking, problem-solving, and scientific reasoning abilities. This includes open-ended questions, problem-based scenarios, research projects, presentations, and essays that require students to apply their knowledge and skills in meaningful ways.
    - **Incorporating Formative Assessment:** We must ensure regular feedback to students on their work to guide their learning, identify areas for improvement, and encourage self-reflection. This can be achieved through feedback on presentations and assignments.
    - **Promote Peer Review and Self-Assessment:** Incorporating peer review and self-assessment activities to encourage critical evaluation, feedback, and collaboration can go a long way. This can help students develop their critical thinking and communication skills, while also fostering a sense of shared responsibility for learning.

Conclusion: A Challenging yet Indispensable Endeavor

The urgency to cultivate scientific temper in India cannot be overstated. It's a call to action for each of us to champion the spirit of inquiry, critical thinking, and evidence-based reasoning. By nurturing these qualities, we pave the way for a brighter future—a future where progress is driven by reason, innovation, and a shared commitment to truth.

By embracing research-driven approaches, implementing evidence-based pedagogical practices, and cultivating a vibrant scientific culture within institutions, we can empower students to become scientifically literate, critically engaged, and ethically responsible citizens. These empowered individuals will be equipped to contribute to India's progress and effectively address the multifaceted challenges of the 21st century. Let's embrace this challenge and work together to foster a society that values and embodies scientific temper.

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“TEACHING AND RESEARCH: ‘HEAD OR TAIL OF A COIN’ OR ‘TWO EYES OF A HUMAN’?”

– Prof. P. Sankar Ganesh, BITS Environmental Science and Technology (BEST) Laboratory, Department of Biological Sciences

I always saw my mom busy with household chores during my teenage years as time ticked in the early mornings and late evenings. She was the Duchess at our home but also a renowned and successful schoolteacher of her time. Whenever I asked her how she could manage these two demanding roles effectively? She always replied, ‘Not one at the cost of another’.

I could relate this to the teaching and research responsibilities of a faculty at a higher education institute. While pursuing a PhD, many would prefer to continue with full-time research as their career. However, if some become university teachers, they must spend substantial time teaching, leaving only the rest for research. The dilemma of ‘Can successful researchers be successful teachers?’ (or vice versa) is always there in most of them.

Teaching involves sharing knowledge, encouraging curiosity, and shaping young minds. It requires empathy, patience, and effective communication. On the other hand, research is about pushing one's boundaries for understanding, solving complex problems and creating knowledge. It requires creativity, perseverance, and analytical rigour. At first glance, teaching and research may appear to be two sides of the same coin, each requiring different skills and commitments. While these responsibilities may seem divergent, they are inherently interconnected.

Teachers actively conducting research offer new insights and up-to-date knowledge to the classroom. When students are exposed to state-of-the-art advancements, their learning experience is enhanced. Similarly, interactions with students can inspire new research questions and directions. Teaching provides a platform for researchers to refine their ideas by explaining them to students (and others), often revealing gaps or new angles that may have been overlooked.

Despite their synergies, the art of balancing research with teaching is nontrivial. A researcher becoming a teaching faculty member comes with the cost of facing time constraints and administrative responsibilities, and there are constant demands for uninterrupted focus, resources, and collaboration. On the other side, teaching can include the task of tailoring lectures to suit diverse student needs, which takes meticulous preparation. Striking a balance between these roles often feels like walking a tightrope. In situations when putting a lot of effort into research or putting teaching first will slow down research development, there is always the risk that excelling in one will come at the expense of the other. But in reality, this may not be the situation...

Various strategies can be employed to integrate teaching and research successfully. One effective way of encouraging students is to engage them in real-world problem-solving by incorporating research activities.

This will allow faculty to align their teaching efforts with their research interest and enhance student engagement. Another method could be to directly engage students in research projects on the topics taught in the courses, whereby the students gain valuable hands-on experience and understand how research works.

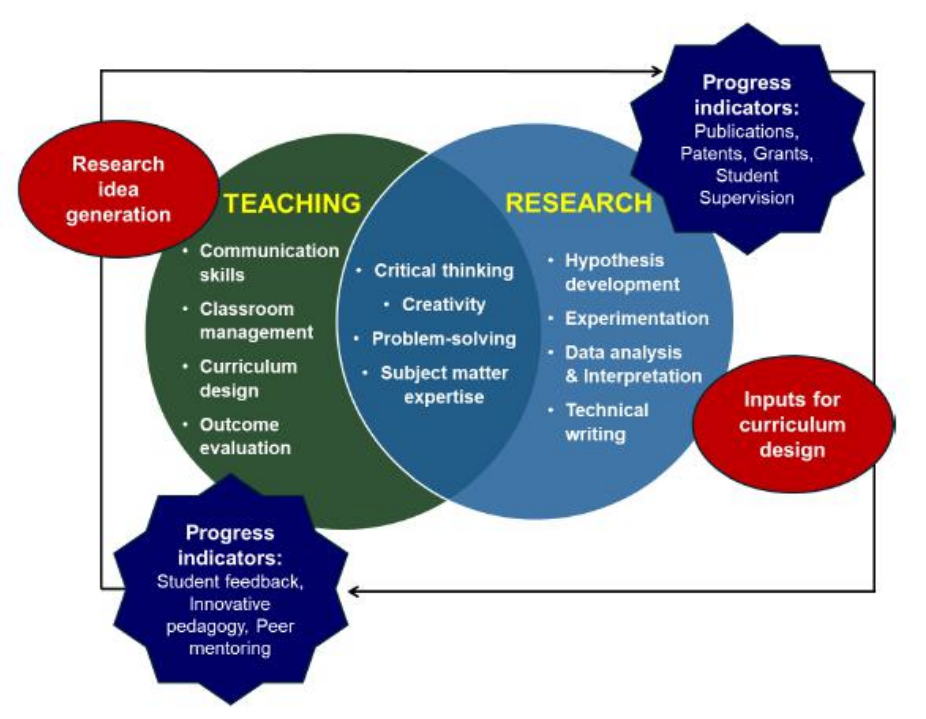
Since 'work expands to fill the time available for its completion', prioritizing tasks and setting short but realistic deadlines are the key factors to balance the teaching and research expectations and administrative responsibilities. Equally important is determining how much time to devote to each task, ensuring that neither teaching nor research is neglected. Although handling these responsibilities might sound complex, when one dives into it, one will learn the depth of values both research and teaching carry. The burden gets reduced when one experiences this journey, which is not like an anxious walk on a rope but a safe track on the rail. Balancing these roles is a pleasure rather than a pressure, bringing joy through the thrill of discovery in research and the privilege of inspiring and guiding young minds through teaching. When approached with passion and curiosity, these responsibilities transform into a rewarding journey where one complements and enhances the other. Embracing interdisciplinary research that aligns with teaching goals broadens the scope of both activities and fosters innovation by exchanging ideas between various verticals of science, technology, and beyond.

Accomplishing teaching and research while maintaining a healthy academic ecosystem involves more than just fulfilling professional commitments. Faculty members who successfully integrate these responsibilities promote a culture of innovation and continuous learning. This dual focus encourages students to view education as a dynamic learning process rather than a static knowledge transfer. Moreover, being a faculty member with a balanced approach builds credibility and adds to those students seeing their teacher actively contributing to their fields, reinforcing trust and respect. It will help students pursue research and take up teaching careers, thereby creating a pipeline of future innovators and thought leaders.

Teaching and research are two inseparable elements of higher education, forming the foundation for academic excellence and societal advancement. The higher education system has continually evolved to integrate these components more effectively. Dedicated semesters or courses for research projects underscore the critical role of research in academic curricula while assigning teaching responsibilities to research scholars ensures they gain pedagogical training. The curriculum is thus designed to harmonize these dual objectives, fostering a symbiotic relationship between teaching and research.

Pedagogical training for faculty members in higher education institutions will play a crucial role in bridging the gap between teaching and research as the training helps effectively integrate the latest research findings into their course teaching practices. The training would also ensure that teaching methods are evidence-based and align with the best practices that would, in turn, equip teachers with the tools to apply and analyze educational research significantly. Additionally, this training will benefit educators' learning, allowing them to gain the skills needed to reflect on themselves and refine their teaching approaches. In training teachers, instead of just being consumers of research, they contribute to the continuous discussion between classroom and research practices. This leads us to the point where we can understand that the relationship between teaching, research, and pedagogical training is cyclic because this helps educators apply their new research findings to their teaching courses. In contrast, during teaching, educators gain valuable insights from the classroom experiences to the research process. This positive ongoing feedback loop ensures that teaching and research are continuously evaluated in response to emerging educational needs and discoveries.

Adopting pedagogical approaches rooted in research has enhanced understanding through experiential learning. Problem-based learning, project-based learning, flipped classrooms, and active learning methods emphasize applying research-based strategies. These approaches are particularly effective in teaching higher-order thinking skills (HOTs). By integrating research into teaching, educators enable students to engage deeply with concepts, encouraging analytical thinking and problem-solving.



Nobel Prize-winning physicist Carl Wieman highlighted the importance of active engagement in learning. In an interview, he remarked, "Rather than sitting, listening to somebody drone away, giving information where the brain is doing very little—essentially just taking in sounds—it needs to be actively thinking about ideas, solving problems, figuring things out with feedback and guidance as it's practising." Wieman also shared that his college years were predominantly devoted to research, with coursework limited to the essentials required for graduation. His insights underscore the significance of integrating research into academic learning to create a dynamic and interactive educational experience. Institutions play a pivotal role as enablers of the harmony between teaching and research. For instance, Birla Institute of Technology and Science (BITS) Pilani offers a structured time allocation framework for its faculty: 40% of their time is devoted to teaching, 20% to administrative responsibilities, and 20% to research, while the remaining 20% is flexible based on individual workload and interests accordingly taking up that left out 20% for teaching or given full-time focus on research or administrative responsibilities. This template ensures that faculty members are given some flexibility in their choice of work but with a balance, thus ensuring that teaching and research work are effectively added to their responsibilities.

Many higher education institutions provide similar guidelines to facilitate a balance between teaching and research. Faculty members are often required to publish research papers as a promotion criterion, encouraging active research engagement. At the same time, students' feedback for the courses taught dramatically adds up to the faculty's appraisal and mandates it as a prerequisite for career progression.

In some universities, faculty members can take sabbaticals for significant research advancements, allowing them to focus entirely on their projects. This opportunity is invaluable for faculty members as it will enable them to dedicate their time efficiently to concentrating on their research work, leading to advancements in their fields. Availing such opportunities provides the faculty with a chance to dwell deeper into their work without the distractions of daily teaching responsibilities at the same time, giving them the time to progress and immerse themselves in high-impact research or coming up with new innovative ideas to carry forward their research. There are many examples where such focused research has led to significant outcomes, including publishing high-impact papers and filing patents for new inventions and spinoffs. Furthermore, sabbatical extends beyond simply taking a break from teaching; it can be just as productive and enjoyable for faculty members more inclined toward their enthusiasm for teaching. Because of this, they are eager to promote and involve more student involvement and to learn from students to improve their work.

Some educational institutes offer teaching track faculty positions to attract exceptional educators as regular employees but with a more significant emphasis on teaching over research. The position maintains an increased teaching load but also participates in minimal engagement for research purposes.

This teaching track focuses more on prioritizing teaching excellence with an emphasis on providing high-quality instruction that enhances the academic environment of educational institutions. On the other hand, research tracks enable faculty members to concentrate on research rather than take on excessive teaching. This allows them to teach occasionally or provide specific tasks as and when needed. This aspect of the job enables the researchers to focus more on working together on research projects, bringing in project students, whether undergraduates or graduates, who share their discoveries with the team and help the lab develop. The positions do not entirely rule out the option of pursuing only one and completely ignoring the other. Still, the degree to which both are taken up differs, giving us a decisive, intense concluding factor of which both are performed and go hand in hand. True research stems from the quest to find solutions to pressing real-world problems. When research outcomes lead to societal betterment or environmental sustainability, their impact becomes far-reaching.

For example, research translated into startups can create jobs and provide innovative solutions to critical issues. Such outcomes enrich the learning experience and equip students with the skills to address complex challenges. Furthermore, impactful research contributes to institutional reputation, attracting funding, collaborations, and talented students and faculty.

Just like my mother said, 'Not one at the cost of another,' I have realized that teaching and research are not opposing forces but complementary paths. Each augments the other, forming a unique growth journey for faculty and students. As the world evolves, the fusion of teaching and research will become even more critical and obligatory. Faculty members must embrace these dual roles not as a burden but as an opportunity to drive innovation, inspire future leaders, and create a lasting impact on society.

“MY EXPERIMENTS WITH TRUTH – IN THE CLASSROOM”

– Prof. Sameera Muhamed Salam,
Department of Computer Science and Information Systems

It was a Wednesday in 2007, and I was in the Data Structures and Algorithms lab, waiting for the students to arrive. I reviewed all the programs we were to discuss in the lab that day. As the students entered, they signed the logbook and took their seats. I began explaining the programs, and they listened attentively. I felt satisfied, believing I had explained everything clearly and that they would perform well on the tasks. As they began working on the programs, I called one girl over for a viva. She came to my desk, and I asked her to sit down. When I asked her a question, I noticed that her face was trembling. At that moment, I realized something was wrong with the way I interacted with students. Although I have been teaching well, something was clearly missing. However, I couldn't pinpoint what that was, as I was comparing myself to the teachers I had encountered and admired.

In 2009, I joined the M.Tech program at NIT Calicut. There, I encountered a professor. Despite being an excellent professor, I noticed that students were afraid to approach him. They never reached out to him with issues, whether it was about submitting assignments or discussing valid reasons for missing an exam. One day, a friend of mine was unable to attend her exam and requested a make-up exam. However, the professor didn’t find her reason convincing (even though it was valid) and denied her request. We were all disappointed by his response. Later, I thought about how I had handled similar situations in the past and realized that I had acted the same way as him—strict and unwilling to extend deadlines, regardless of the circumstances. I saw myself in him, like a mirror image.

I began observing other professors in our department at NIT Calicut. They were also excellent educators, managing their classes effectively. At the same time, they were friendly and approachable. They ensured that we completed tasks on time, yet no one felt nervous to approach them with any issues. They always provided helpful solutions to students. They had a perfect balance, and that’s when I realized that being approachable is also an essential quality for a teacher.

In 2011, I returned to the college where I had previously taught. I made a conscious effort to become a more approachable teacher. I started actively listening to my students. Although I had always been a caring teacher, my students were unaware of it. They viewed me as strict and believed I wasn't considerate towards them. I realized that it was important for students to recognize that their teacher genuinely cared about them. I noticed a change in the way my students treated me. They would always smile and greet me. They began coming to my office, spending time with me, and approaching me to clear their doubts or seek guidance for the future. They started sharing their happiness with me. The teacher I was before 2009 and after 2011 is a completely different one. The students I taught after 2011 continue to stay in touch with me to this day. They have a deep sense of respect and care for me.

One characteristic I've observed in the current generation (from my experiences) is that their patience level is quite low. One such example occurred recently when I gave an assignment to my students with a deadline of October 14, 11:59 PM. Some of them attempted to upload their assignments at 11:58 PM but were unable to do so due to network traffic. I started receiving emails from them starting at 12:00 AM on October 15. Since I was busy that day, I couldn't respond immediately. A few students came to my office, and I told them that I hadn't yet decided how to handle the late submissions and would inform them later. Most of them left after hearing this, but one student stayed. Despite my request for him to leave, he refused, and only after I raised my voice did he finally leave. About 30 minutes later, I received a call from the Head of Department, and I explained the situation. The students who approached the HOD lacked the patience to wait for my decision regarding the late submissions. They want to see results quickly, and if they don't receive real-time feedback, their interest in those activities tends to fade rapidly.

Another thing I've observed is that if a teacher or mentor isn't up-to-date with current industry trends, they struggle to keep students engaged and interested. I taught Logic in the Computer Science course twice at BITS. During my first time teaching it, both I and the students found it boring. I focused solely on the textbook material without connecting it to current trends. Even though I delivered the lecture well and explained the concepts clearly, it wasn't successful. While a few students were interested, I couldn't capture the attention of most of the class. Before teaching the subject for the second time, I conducted extensive research on the topic and focused on highlighting its relevance to current trends. As a result, the class became much more engaging. I noticed a higher attendance, with more students actively participating and asking questions.

In conclusion, my teaching journey has taught me the importance of being both approachable and adaptable, rather than simply being a stern lecturer. I realized that a teacher should not only explain concepts clearly but also connect them to real-world trends to keep students engaged. By reflecting on my experiences, I understood that fostering an environment where students feel comfortable and cared for leads to better interactions and learning outcomes. Additionally, incorporating personal experiences and encouraging critical thinking helps stimulate curiosity and deepen understanding. Ultimately, a teacher's ability to evolve and relate to students plays a crucial role in making learning more meaningful and impactful.

“WHAT IS THE ROLE OF A MENTOR!”

– Prof. Y V D Rao„ Department of Mechanical Engineering

An experienced person who helps a less experienced individual, called a Mentee, learn and grow by sharing his knowledge and expertise is a Mentor. Thus, a mentor is one who supports, advises and guides a mentee. Mentor must take time to understand the mentee and assess the challenges a mentee has to face. Further, he must have an understanding of the mentee, knowledge and expertise to help him improve. For the mentee, mentor is a source of knowledge, wisdom and support.

Normally the words Supervisor, Advisor, Guide, and Mentor are used interchangeably. However, there is an appreciable variation in these roles. A supervisor communicates the research needs, oversees mentee performance and provides guidance. He identifies the need for development and provides feedback. He also ensures accountability to the system and regulatory bodies. Thus, a supervisor's role is to oversee an individual or group to ensure that the task is executed properly. Whereas a mentor's role is to help a mentee develop skills needed and grow as a person, besides providing an emotional support.

Guide is a faculty member who assists with planning, execution, evaluation, and feedback so as to maintain desired standards and offers intellectual, ethical, and professional support while encouraging critical thinking and ensuring research integrity. A guide typically helps with specific situations or tasks, while a mentor is a long-term advisor who provides guidance on a broader scale.

An advisor provides targeted advice about a specific event or situation, often without regard to the individual's personal needs or passions. Advisor may be expected to be more directive than other roles. Clearly, the roles are different, yet they are closely related. Hence, there is a temptation to use them conveniently.

Obviously, mentor has a better role to play and provides guidance, advice, feedback, and emotionally support. Further, he has to be a role model. He must be a teacher, counsellor, advisor, sponsor, advocate, and ally. He has to help the mentee understand the workplace culture and environment. He must assist the mentee in setting up goals and chalk out a work plan in order to achieve the goals with an aim of overall and long term based development of the mentee. Mentoring is a voluntary work, whereas supervision is not, because any mentor's time and knowledge are given willingly.

Mentor provides feedback and guidance to the mentee. One of the major differences between these two is that supervision is always task-based, like setting schedules for completing a thesis or dissertation, whereas mentoring is about caring for a scholar's overall and long-term development from a holistic perspective. The mentor works closely with a mentee and assesses his strengths and weaknesses. Mentor requires some amount of experience before start providing direction, advice, and resources. Mentor role is not merely to pass orders. Mentor must throw challenges and help a mentee develop problem-solving skills.

Being a mentor is a huge responsibility. A mentor must have an ear to listen and ensure that mentee has a fair chance of success in his career. A mentor with good problem-solving abilities can help guide the mentee to take appropriate action. Patience is a key quality people need to have, more specifically as mentors. Mentors raise mentee's confidence and problem-solving abilities. Along with developing leadership skills, having a mentor to advise and guide you can increase a scholar's confidence and help develop problem-solving skills. Regarding confidence, research has shown that having a mentor results in an overall increase in emotional health.

The qualities of effective mentors may be organized into four general categories:

- Attitude and character
- Professional competence and experience
- Communication skills
- Interpersonal skills.

Some characteristics of a good mentor include:

- he must be knowledgeable,
- a good listener,
- give constructive feedback,
- always be supportive.

Mentor must have focus on the mentee, be a role model to the mentee, and be passionate and have to be positive in attitude. A good mentor listens, but also gives their own opinion. They do not dictate, but advise. They are available to the mentee for support and as a resource. He must provide guidance, and share expertise and experience. Mentor has to be empathetic, genuine, and truly have mentee's best interests at heart.

As already mentioned, mentors must be good listeners, because they should spend 80%of time listening, next 10% of time questioning in order to delve into important topics, and remaining 10%of time providing advice.

A protagonist has abilities in overcoming obstacles at any time and in any area. A mentor is however, an archetype character who is a guide, advisor, and teacher to the protagonist. The mentor possesses knowledge, skills, and experience that the protagonist lacks, and help the protagonist achieve the tasks.

Socrates, the great Greek philosopher lived during 470 and 399 BC mentored Plato, who in turn mentored Aristotle. Mentoring chain continued and Aristotle was the mentor of Alexander, the Great. Another example of mentor and mentee combination is Chanakya and Chandragupta. Chandragupta ruled Mauryan Empire during 321 to 297 BC and became emperor under the mentorship of Chanakya. Vijayanagara Empire during 1471 lnd 1529 AD was ruled by Krishnadevaraya and he was mentored by his prime minister Timmarusu, who was called by the king as Appaji, meaning father. Dronacharya and Arjun form another mentor and mentee pair. A well-known relationship as teacher and student, and Dronacharya as mentor took special care to train Arjun learn best archery skills.

Mahatma Gandhi mentored Jawaharlal Nehru, the first Prime Minister of India. Martin Luther King, Jr. considered, Benjamin Mays as his spiritual mentor. Howard Thurman, mentored and introduced and encouraged Martin Luther King, Jr. to read the teachings of Gandhi. Vivekananda was mentored by Ramakrishna Paramahamsa.

Warren Buffett and Bill Gates, most successful entrepreneurs of our time have a close mentor-mentee relationship. Steve Jobs, co-founder of Apple is considered as the mentor for Mark Zuckerberg, the creator of Facebook. Zuckerberg, acknowledges Jobs as his mentor and said Steve gave guidance on creating a business with an outlook for the future. Elon Musk, CEO of Tesla and SpaceX has drawn inspiration from Benjamin Franklin, Steve Jobs, Albert Einstein, Isaac Newton, and Nikola Tesla and considered them de facto mentors.

A good mentor does not limit himself to impart knowledge from his experiences. He looks at the mentoring relationship as an opportunity to grow professionally and personally. Hence, the best mentors develop a genuine interest in mentoring because it offers many benefits to them as much as it does to the mentee. Mentors can provide specific insights and information that enable the mentee's success.

Individuals starting to mentor may get benefited from this information as it helps them feel comfortable in the role more quickly. The most important task of any mentor is to help his mentee understand and define the goals. Many mentees have difficulty mapping out their needs or arranging them according to priority. With the mentor's help, a mentee identifies with clarity the goals, which is primary part of mentor-mentee relationship

It is important to lay down some ground rules and expectations at the beginning of the mentorship. Right in the first meeting, define how often meetings should happen, place of meet, and what is the agenda for discussion. Having these expectations set, smooth mentoring is ensured. Though mentorship is a professional relationship, taking a genuine personal and emotional interest in the mentee enhances the functioning of the mentee. This results in getting to know each other and helps work better together.

A key part of working together is define short-term and long-term and monitoring the schedules. Providing right feedback constructively is essential part of mentoring. Though direct and frank feedback is desirable, softened blow is needed for some mentees. Mentor has to assess the emotions of a mentee and modify the nature of feedback. Also, the timing of feedback is also important, because, after all, being a good and pleasing communicator is one of the pivotal qualities of a good mentor.

Mentor must identify blind spots of a mentee, help him recognize and overcome them. Mentor should practice emotional intelligence. That is, mentor must listen to what a mentee tells, yet read between the lines to gain a better understanding of the mentee.

Mentor has to share relatable stories from his experience, personally or with others. Mentor needs to help a mentee develop independent thinking and provide an opportunity to figure out things on their own so that mentee problem solving skills develop.

Mentor must instil confidence in a mentee. From a mentee standpoint, this is vital to a successful mentor. If a mentee needs development in an area in which mentor has less expertise, using his network he must put the mentee in touch with an expert in that area. If a new opportunity is suitable, it must be put forward to the mentee and advocated.

Honesty is a key ingredient of great mentoring, since it builds trust in a mentoring relationship. Mentor has to share his own failures and successes with the mentee so that mentee realises that learning and achieving is not always rosy. This helps the mentee get benefited from the lessons and know the pitfalls that come in his own journey.

Rules for mentoring are only for guiding. Intuition should prevail upon the actual situation. When well-informed about the topic, person, or context, intuition can be trusted upon to reflect deep levels of processing below consciousness. --- Happy Mentoring.

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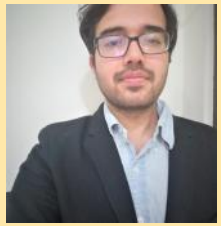

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