From the art of teaching to the science of learning

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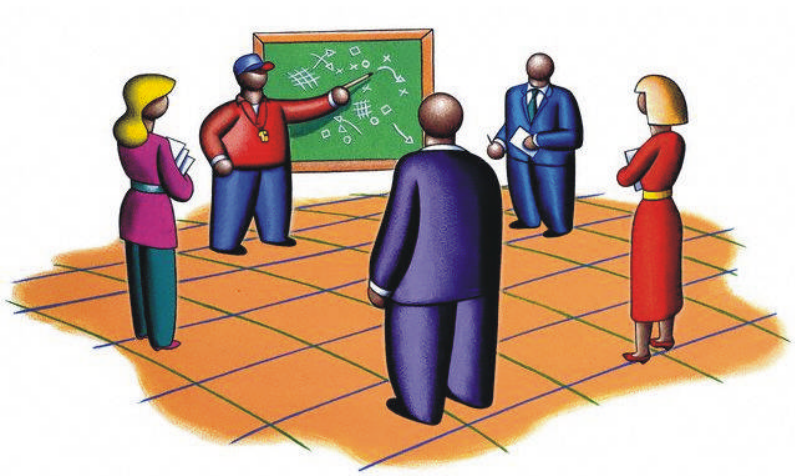
The occasion of Teacher's day, is an opportune time to reflect upon the nature of the teaching activity, the evolution of the teacher's role and its future especially in the light of impact of technology and the migration from an exclusive approach of education to an inclusive universalisation of education as the key to flourishing and thriving in the knowledge economy. And when one wants to describe the new paradigm in education, which is emerging as a result of the developments in the last few decades, it is I think fairly well expressed as the title of this piece, the shift "from the art of teaching to the science of learning". Traditionally good teaching was an art learnt at the feet of the masters through long periods of internship and following good examples and practices. A great teacher was like a master artist or sculptor, who from the rock of his vast knowledge chiseled out in real time before his audience a form of the knowledge construct appropriate for his learners. However the problem with this artistic form of teaching was that it was not scalable, and we saw in the past decades a sudden expansion in the number of colleges, universities and students in higher education coupled with a substantial decline in the standards, so much so that now we agree that by and large the higher education system is incapable of meeting the challenges of quality with quantity. The structure of matter, the nature of the cosmos and of the human mind, and its relationship to the brain are some of the overwhelming questions that have engaged thought-leaders throughout history.



Until recently, understanding the mind--and the thinking and learning that the mind makes possible--has remained an elusive quest, in part because of a lack of powerful research tools. Today, the world is in the midst of an extraordinary explosion of scientific work on the mind and brain, on the processes of thinking and learning, on the neural processes that occur during thought and learning, and on the development of competence.

These have important implications for education. New understanding of the learning process is leading to many different approaches to the design of curriculum, teaching, and assessment that differ almost entirely from those found today.

For most of the previous century, the focus of education was on the imparting of literacy skills: simple reading, writing, and arithmetic. Even at the University level it was about mere acquisition of information, often from different sources. But it was only at the research level that students were trained to read and think critically, to express themselves clearly and persuasively, to solve complex problems in science and mathematics. Now, at the beginning of the new century, these aspects of higher level cognitive skills are required of almost everyone in order to successfully cope with the complexities of contemporary life. The skill demands for work have changed dramatically, with the result that 'the skills of a lifetime become obsolete in an instant' as has the need for organizations and workers to change in response to competitive workplace pressures. A responsible participation in the democratic process has also become increasingly complicated as the focus of attention has shifted from local and divisive to national and global unifying concerns and no longer limited to casting a vote once in five years to a practical participation through exercising the rights conferred in the recently enacted Right to Information Act. Now that we have a large number of interdisciplinary inquiries and new teams of scientific collaborations, the path from basic research to educational practice is somewhat clearer, though not yet easy to pursue. Till recently, educators paid little attention to the work of cognitive scientists, and researchers in cognitive science worked in laboratories far removed from classrooms. Today, cognitive researchers are spending more time working with teachers, testing and refining their theories in real classrooms where they can see how different settings and classroom interactions influence applications of their theories.

What is perhaps currently most striking is the variety of research approaches and techniques that have been developed and ways in which evidence from many different branches of science is beginning to converge. For example:

- Research in cognitive psychology has increased our understanding of the nature of competent performance and the principles of knowledge organization that underlie

people's abilities to solve problems.

- Developmental researchers have shown that young learners can understand a great deal which make it possible to create innovative curricula that introduce important concepts for advanced reasoning at early ages.
- Research on learning and its transfer has uncovered important principles for structuring learning experiences that enable people to use what they have learned in new contexts.
- Work in social psychology, cognitive psychology, and anthropology is making clear that all learning takes place in settings that have particular sets of cultural and social norms and expectations and that these learning environments influence learning in powerful ways.
- Neuroscience is beginning to provide evidence for many principles of learning that have emerged from laboratory research, and it is showing how learning changes the physical structure of the brain and, with it, the functional organization of the brain.
- Current and emerging technologies are leading to the development of many new opportunities to guide and enhance learning that were unimaginable earlier. Above all, information and knowledge are growing at a far more rapid rate than ever before in the history of humankind. Also, the meaning of "knowing" has shifted from being able to remember and repeat information to being able to find and use it. More than ever, the sheer magnitude of human knowledge renders its coverage by education an impossibility; rather, the goal of education is better conceived as helping students develop the intellectual tools and learning strategies needed to acquire the knowledge that allows people to think productively about specific areas of human knowledge, such as history, science and technology, social phenomena, mathematics, and the arts. Fundamental understanding about subjects, including how to frame and ask meaningful questions about various subject areas, contributes to individuals' more basic understanding of principles of learning that can assist them in becoming self-sustaining, lifelong learners.

New developments in the science of learning also emphasize the importance of helping people take control of their own learning. Since understanding is viewed as important, people must learn to recognize when they understand and when they need more information. What strategies might they use to assess whether they understand someone else's meaning? What kinds of evidence do they need in order to believe particular claims? How can they build their own theories of phenomena and test them effectively?

Many important activities that support active learning have been studied under the heading of "metacognition". Metacognition refers to people's abilities to predict their performances on various tasks (e.g., how well they will be able to remember various stimuli) and to monitor their current levels of mastery and understanding.

Teaching practices congruent with a metacognitive approach to learning include those that focus on sense-making, self-assessment, and reflection on what worked and what needs improving. These practices have been shown to increase the degree to which students transfer their learning to new settings and events.

The future model of teaching-learning would therefore be based on an educational diagnostics and navigational services approach, with high-tech approach to facilitate student teacher interaction. Adoption of Internet services, push technologies, personalization, chunking of learning into small re-usable learning objects (RLO's), online communities and especially the use of cellular phones, personal digital assistants etc., would allow access to educational opportunities from the palm of the learner's hands. The next generation media of great appeal to the screen-agers would totally transform education in a somewhat similar way that provision of healthcare and medical services were transformed as the results of advanced scientific and medical research, and continues to promise improvement. Just as infant mortality, and deaths from many earlier mass killers like malaria, typhoid, tuberculosis etc., have been all but eliminated, the right combination of technology and scientific research in the cognitive sciences hold out the promise of removal of illiteracy, ignorance and the possibility of a new generation that can propel the country on to the desired path of global leadership.