

Computers and education

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There is a general feeling among the educators and the educated that they will be left behind in the absence of computers. The denied reality is that, they cannot run ahead in the presence of computers. Computers certainly enable several activities; however its role in education and learning has to be carefully understood.

The good vicar of Oliver Goldsmith's the *Vicar of Wakefield* said 'I chose my wife, as she did her wedding gown, not for fine glossy surface, but such qualities as would wear well'. How very true these words are for education as well. Computers, white boards, projectors, power points, canned software, etc. create a glossy ambience, but do precious little to the real transfer of knowledge or learning. Across the country, in thousands of educational institutions, glossy multimedia classrooms are being added with computer furniture, white boards, computers, projectors, plasma screens, etc. This is certainly huge business for the infotainment industry; whether this will promote habits that will wear well is anybody's guess.

Inquiry is the key to the house of learning. Great masters are known more for their spirit of inquiry than for their explanatory discourses; see Rudyard Kipling's poem from *Just-so Stories for Little Children*.

'I have six honest serving men; they taught me all I knew.
Their names are What, Where and When; and How, Why and Who.'

Education covers the full spectrum of 'what' (numerals, languages, information, organization of information), 'where and when' (geography and history), 'how and why' (technology, engineering, science), and 'who' (humanities). The first two sets of questions belong to the domain of raw information and organized information. The next set of questions addresses skill development and conceptual knowledge. The last question relating to the humanities addresses the making of man. One might say that the purpose of education may start in pursuit of a living, but has to culminate in making a life. Liberation is the goal of education. The first

and final questions form the famous pair 'What is this world? And who am I?'

Consider the subject of arithmetic. Numbers, operations, rules governing these operations may be readily identified at the level of information and organized information. Every subject discipline has this first level of 'show and tell'. The addition and multiplication tables are at this level. In languages, this level is limited to alphabets, vocabulary and grammar. The quotation given at the beginning of this article (Oliver Goldsmith's) contains no words beyond high school vocabulary. The structure of the sentence is also simple. However, what has been expressed in that sentence touches something sublime which transcends the context. Such mastery of a language is much more than alphabets, words and grammar.

We may first identify the strengths of computers. Computers are extremely well suited for data rich, memory intensive, knowledge neutral, agent neutral applications. The first application that comes to mind is book-keeping. It is no secret that inventory and payroll processing were the first applications, which heralded the current era of computers. One of the most successful examples in our country is the railway reservation application. This is certainly a textbook example of data rich, memory intensive, knowledge neutral and agent neutral application. In the context of education, what are the limitations of the computer? Are the students and the teaching community fully aware of these limitations?

A computer is a fast and huge look-up table. When an apparently intelligent task of spell check of a composition is carried out, or when a computer is programmed to play chess with a grandmaster, an appropriate look-up table is consulted and suitable response is selected. Computers are extremely well-suited for data rich, memory intensive applications. In learning and education, computers can certainly address the first level of 'show and tell'. There are less expensive and more effective methods available for 'show and tell' category of learning than computers.

The next level of learning is related to 'when and where'. These questions address history and geography. At a cataloguing level, they relate to period and people, and environment and events. *Bhagavad-Gita* may be seen as a record of events and people at this level. And so are many of the religious literature. However such literature certainly go beyond 'when and where'. They are considered eternal wisdom; they handle 'how' (to live), 'why' (understanding is necessary) and go on to speculate about 'who' (is responsible). The insights from the past and history are personal; they are buried deep beneath the 'show and tell' level of exposure.

Computers are appropriately classified under information technology (IT). The beginning of IT may be traced to the invention of the printing press. This invention (Gutenberg, 1440) made possible the printing, preserving and transmitting of information. This was followed by radio (DeForest, 1907) when the spoken word could be recorded and transmitted over a distance. The next innovation was the television (1926) – combined effort of several inventors – which made possible the recording, and transmission of still and moving images. The important point to notice is that whether it is the printing press or the radio transmitter or the TV transmitter, all of them only handle information. They do not create content. The compositor in a press is not the author of the article that he is typesetting. The same is true in radio and TV as well. The modern personal computer (1982) combines all these IT tools along with huge memory. It has a printer, receiver and transmitter, a monitor, speakers, mike and camera, huge memory and fast data processor. In this capacity it is a complete 'show and tell' machine.

The third level in learning covers 'how and why'. These questions relate to technology and science. A nation's strength and stature, wealth and well-being are all determined by the state of its science and technology. The pursuit of natural sciences have grown enormously in the past several centuries into physical sciences, chemical sciences, electrical sciences, mechanical sciences, biological sciences

and so on. A committed and competent cadre of engineers and scientists are the prime movers of any nation. They determine the intellectual and physical assets of the country. Developing and nurturing these assets require clear vision and purposeful action. The curriculum has to cover in a few years, the core ideas that have been in the making for centuries. All these have to be learnt in the proper sequence with adequate depth. Good analytical skills have to be acquired with the necessary classical base. Learning has to be internalized through appropriate exercises. The theories learnt have to be confirmed through laboratory work. The validity and limitations of everything learnt have to be constantly kept in mind. Exposure to the current applications and practices is essential. It is easy to appreciate that simple 'show and tell' machines are going to be woefully inadequate for this challenge. A number of elemental tasks can be carried out through mentored or guided exercises involving computers.

The questions 'what, where and when' belong to the group of 'observational learning' and 'associative learning'. 'Show and tell' machines may conveniently assist them. The questions 'how' and 'why' belong to a different paradigm in learning. These belong to the class of 'constructivist learning'. Constructivism is associated with learning by doing. 'Show and tell' machines are inadequate in such situations. Besides, this learning is an active process in the company of a facilitator; this is in contrast to the classical passive learning from a teacher.

Through a simple example, we may illustrate this process. 'How to make dosa' is the learning example. There are a several distinct steps.

1. Mix urad dhal, rice and methi seeds in right proportion and soak it in water overnight.
2. Drain the water and grind the mix in a wet grinder to right consistency.
3. Allow the batter to ferment for a few hours and add salt to taste.
4. With flat pan, ladle and spatula, make the dosas with the batter and oil.

One will notice that the steps are not precise. For example, the right mix in step 1, right consistency in step 2, and number of hours in step 3 leaves room for

variation. It is rightly so. There are several variants and the practitioner will learn by doing from a facilitator. Further, the student may experiment with rava, ragi, jowar, etc. in place of rice (carbohydrate) and tur dhal, green dhal, etc. in place of urad dhal (protein). In fact, this kind of learning liberates the student towards several creative possibilities. One may certainly use a 'show and tell' machine to demonstrate the process. But the education is not complete till one makes a few dosas. Several variants have to be mastered to reach full competence. This is the essence of learning by doing.

Let us see the hazards of a 'show and tell' machine – or web-based learning for this process. The steps will appear as follows.

1. Buy the batter from company ABC. Check for freshness and loyalty discounts.
2. Add proprietary dietary supplements to get your daily supply of all essential minerals.
3. Get a 'dosa making kit' (with free video CD) from company XYZ.
4. Follow the steps and serve with any vegetable filling (available from company PQR).

Notice that each step is converting the learner into a helpless, captive consumer. Even before one has read these steps, one would have been bombarded with several pop-up windows trying to sell items from undergarments to Ph D degrees. The learner will never become fully functional and liberated. A similar process is happening in all our portals of higher education on account of the commercial interests of proprietary software.

The next level in learning is to find answers to the question 'why'. This in essence is engineering and science. This level of learning is fundamentally different from the earlier levels. In the earlier levels, the observations, associations, constructions are all in the known domain. The question 'why' on many occasions, links the known to the unknown. Whenever the question 'why' is successfully answered, the boundaries of the known (knowledge) expand. The legendary question, 'why the apple falls to the ground?' by Isaac Newton belonged to this category. In this respect, no machine can ever address this aspect

of learning. The methodology is as follows.

1. First make a proposition addressing the 'why'.
2. Then experiments are designed to verify the proposition.
3. Measurements are made to prove/disprove the proposition.
4. Several experiments may have to be carried out to carefully map the cause-effect links to firmly establish the original cause to final effect chain.
5. Many of these experiments are carried out through simulation.

This work probably involves the most intense intellectual effort and significant perseverance to establish the linkages. This is one of the most exciting areas of research and development; this work combined with the ensuing technology and applications results in the most significant pay-offs. Computers are useful in step 5 as brute force substitute for intuitive insights of experts.

How relevant are computers in the learning process? Where do computers belong in the learning landscape? To what extent do the five star multimedia classrooms enable the student? I tend to believe that computers are predominantly employed as 'show and tell' machines in the classroom. In that capacity, there are several less expensive and more effective learning aids available to the student. Computers can be quite effective in assisting students to learn vocational skills in appropriate measures; the stress has to be on 'doing' by the student. However, the commercial interests tend to convert the students into consumers without empowering them on to the path of creativity. In the most important area of learning science and carrying out research, the net influence of computers is debatable; the reason is the overbearing presence of proprietary software in the learning environment. Open source software and discriminating mentors are essential. Vigilance from the teaching community is crucial so that the students become truly learned, free and functional.

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