Technology Enabled Science Education at University Level

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Abstract: *The Information and Communication Technology (ICT) is linked to the idea of 'innovation' in higher education, and can facilitate the quality enhancement in a knowledge society. ICT is producing a major change in both the content and the process of science learning. Technology can make learning of science a reality. The university system can endorse the knowledge creating the means by which individuals can acquire the scientific skills and principles. The use of technology can certainly assist to provide individual differences among pupils in terms of achievement in diverse academic areas. Technology and its use might well guide pupils to develop wholesome attitudes towards learning. Therefore it is very much needed to integrate technology in teaching of science at tertiary level. This paper is an attempt to highlight the technology enabled science education at university level in India with special reference to Tamilnadu.*

I. Introduction

Science is a dynamic, expanding body of knowledge, covering ever-new dimensions of experience. In a progressive forward looking society, science can play a truly liberating role, helping people escape from the various cycles of poverty, ignorance and superstition. The plethora of changes taking place in science and technology, in society and in the economy has lead to efforts by all the developed and developing countries worldwide to renovate education in the sciences. The scientific approach will only kindle the spirit of inquiry in children. Teaching science is an exciting experience. Science and technology are always instrumental in enhancing efficiency in all human endeavours. Particularly the technology enabled education can provide valuable help for smoothing the teaching - learning process and achieving the goals of education. Information and communication technology is a revolution in the path of the development and improvement of the world of education.

II. Higher Education and Knowledge Society

The information and communication technology is linked to the idea of 'innovation', and can facilitate the development in a knowledge society. The concept of 'knowledge society' includes a dimension of socio-political, cultural, economical, institutional transformation, and a more pluralistic developmental perspective. It captures the complexity and dynamism of the changes taking place in the contemporary societies. Higher education can impart scientific knowledge and skills among the youth through its academic programmes, research and extension services. The university system can endorse the knowledge creating, by which individuals can acquire the immediate skills and knowledge especially on science education. The National Knowledge Commission of India (2008)[1] has recommended five key areas of the knowledge paradigm – access to knowledge, knowledge concepts, knowledge creation, knowledge application and development of better knowledge services, and it will also help to achieve the Millennium Development Goals through technology enabled learning.

Looking at the complex scenario of science education in India, three issues standout clearly. First, science education is still far from achieving the goal of equity enshrined in our constitution. Second, science education in India, even at its best develops competence but does not encourage inventiveness and creativity. Third, the over powering examination system is basic to most, if not all, the fundamental problems of science education in India. For any qualitative change from the present situation, teaching of science in India must undergo a paradigm shift. Science courses make students mostly to memorize a series of dry facts. Science education should persist with idealized view of science as objective, detached and value-free subject. The study of science should develop among students reflective, critical and logical reasoning.

III. Curriculum Reform

Scientific knowledge can best be presented as a set of 'explanatory stories'; technology can no longer be separated from science; the university level science curriculum must give more emphasis to key 'ideas about

science'. Science should be taught using a wide variety of teaching methods and approaches; assessment needs to measure pupils' ability to understand and interpret scientific information; change in the short term should be limited; and a formal procedure needs to be established for the testing of innovative approaches at the university level. Reforming the higher education science curriculum to meet the challenges of contemporary society faces a number of obstacles that must be addressed and met. These are the limitations of the qualifications and abilities of the science teaching force; the problems with developing appropriate modes of assessment; the resistance of well-established stakeholders; and the culture of science teaching.

New science curriculum should give more emphasis to develop an understanding of the nature and processes of science and expand the emerging dimensions of science. The nature of the roots of scientific knowledge is excised to present science as a body of unequivocal, unquestioned and uncontested knowledge which has been the successful, linear progression of the work of isolated great men, devoid of any cultural context.

IV.   Science Education

The emphasis in most science instruction is on helping students acquire what has come to be accepted as a fundamental base of scientific knowledge. As a result, only a small portion of students come away from science courses at university with understanding of, or capability to use and apply science in everyday life. On the contrary, a majority of students develop fear and dislike for the subject, which result in making a firm commitment not to study the subject further.

Nevertheless, the enrolment in science course in India is quite progressive. The growth of enrolment of students in science groups compared with the other fields of study and the course wise enrolment of students in higher education in Indian universities have been depicted in Table 1.

Table 1
Growth of Enrolment by Field of Study during the Eleventh Plan (lakh)

Faculty	2007-08		2011-12		Increase	Growth rate %
	Total	%	Total	%		
Arts	59.3	38.45	61.78	**30.61**	2.48	0.8
Science	27.37	17.75	31.27	15.49	3.9	2.7
Commerce & Management	24.41	15.83	29.87	**14.8**	5.46	4.1
Education	7.32	4.75	11.95	**5.92**	4.63	10.3
Engineering	24.14	15.65	48.96	**24.26**	24.82	15.2
Medicine, Nursing & Pharmacy	6.86	4.45	10.91	**5.41**	4.05	9.9
Agriculture & Veterinary Science	1	0.65	1.21	**0.6**	0.21	3.9
Law	2.69	1.74	3.27	**1.62**	0.58	2.4
Others	1.11	0.72	2.74	**1.29**	1.63	19.8
Total	**154.21**	**100**	**202**	**100**	**47.65**	**5.6**

Source: MoHRD, UGC,India [2]

The rate of enrolment has been increased to a percent of 2.7 but still the total enrolment of students in science groups (15.49%) remains lower to that of the arts groups(30.61 %) in higher education which is represented graphically in the Figure.1 given below.
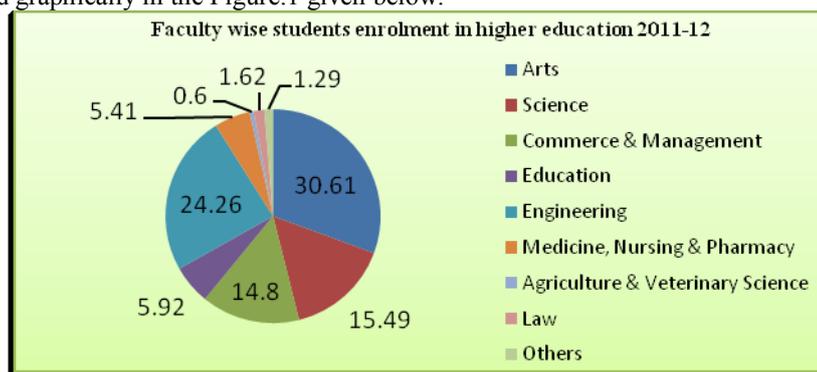
Source: MoHRD, UGC,India [2]

Fig . 1 Faculty wise students enrolment in higher education 2011-12

V. ICT in Science Education

Information Communication Technologies are used to achieve higher educational goals, rather than being an end in themselves, curriculum pertains to regular mainstream subjects, transacted by regular university teachers and teacher educators. Capacity building training should be arranged for university teachers and teacher educators on 'techno-pedagogical' applications of ICTs in education. Techno-pedagogy is the integration of technology in the pedagogical strategy. Integrating the innovative technologies and strategies for science education should inculcate the scientific knowledge and skills among the students.

Building a network of university teachers focusing on their professional developmental and affiliation needs; and the collaborative design and development of digital learning resources, using public software educational tools would enhance the quality of teaching learning process of science education. Creating an online community of university teachers will enable to constitute the forum to share resources, seek assistance and voice their opinions on science education policies and to exchange day-to-day classroom instructive transactions. Ultimately, the goal is to enable teachers to grasp the advantages of peer networking, break away from working in isolation and become active participants in the public education system. The teachers should be able to identify the ways of effectively integrating ICTs for their classroom transactions.

In science classrooms, the students can have an optimal learning experience if they are provided opportunities by the teacher to construct their own knowledge instead of having knowledge constructed for them. This is the essence of the constructivist science learning. In science classes, teachers should create an environment that requires the student to state their point of view. Participation of students to construct knowledge is to be maximised and the evaluation should be made based on active participation and performance of the learner (Sreedevi & Sudhir,2011)[3]. Students should have freedom and autonomy within the pedagogic parameters. The focus on pupil-pupil interaction and teacher-pupil relation in the classroom can empower the learning process and the learner in a constructivist classroom.

VI. Computer Assisted Instruction (CAI)

According to Reksten (2000)[4], "technology is not a curriculum, but a tool for curriculum. Concept based teaching along with technology tools will elevate student thinking and improve overall achievement". The use of computer in education paved the way for the introduction of technology on a larger scale in the teaching-learning process.

One of the most exciting innovations in education technology is the Computer Assisted Instruction (CAI). Computer Assisted Instruction assists in the preparation of instructional materials for students to monitor the learning process or to select additional material in accordance with the needs of the individual learner. This instruction starts by identifying the way a student seems to learn best. It reviews his past history of learning and then present a programme built on his strength. Therefore, Computer Assisted Instruction is not merely a sophisticated type of programmed instruction but a different kind of instruction altogether. It may be defined as a method of instruction in which there is a purposeful interaction between a learner and a computer device having useful instructional materials as software for helping the individual learner to achieve the desired instructional objectives at his own pace and with the abilities at his command.

Computer Assisted Instruction is defined as an interaction between a student, a computer controlled display and a response entry device for the purpose of achieving educational outcomes. Computer Assisted Instruction has become an integral part of the learning process in the advanced and developing countries in the world. The Computer Assisted Instruction can be used for teaching and instructional purpose in the field of education. CAI is a highly individualised instruction device and can be profitably employed in higher education programmes particularly for developing scientific skills and competencies among the students and updating the knowledge and professional advancement of the teachers (Sreedevi & Sudhir,2011)[5].

VII. Multimedia Education

In learning, the emphasis is on creating environments where learning can be more lasting with the support of developing technologies. It has been ascertained that people can remember 20% of what they have only seen, 40% of what they have seen and heard, 75% of what they have seen, heard and done (Neo & Neo, 2001)[6]. Multimedia learning allows for a high level of independence in the learning process. Multimedia learning environment based on constructivist learning theory, intrinsically motivate students learning. Multimedia has the potential to enhance learning. Multimedia presentations can be viewed by a group of students at a time. Science concepts can be explained more effectively through multimedia presentations. The media can make the students to understand the clear happenings in the science processes and products. The influence of multimedia package can be used to improve the achievements of the students.

The students having the habit of analyzing scientific concepts in their own perspective find multimedia as a boon for their learning process. Multimedia education would be very useful to demonstrate visually the scientific ideas and concepts; it instills a sense of wonder and excitement in learning science, provides real life

examples for the students in learning process, thereby increasing the interest towards learning science. Also multimedia education in science at university level would lead to promote various skills like critical thinking, problem solving skills among students.

The Aakash tablet is one of the most ambitious projects taken up by the Indian government to impart technology based education in schools and colleges. Aakash is an android-based touch screen PC tablet designed specially to fulfil the educational requirements and needs of the students and for those who cannot afford high – priced gadgets [7]. It is the cheapest android tablet in the world that has got global recognition because of its high-utility in an extremely low cost.

VIII. Free laptop scheme for students in Tamil Nadu.

In a pioneering initiative, in India, the Tamil Nadu government is providing free laptops to students of government-run and government-aided higher secondary schools, arts and science colleges, engineering colleges, and polytechnic colleges. The scheme, which will cover 912,000 students this year at a cost of Rs.912 crore, is designed to give a major boost to Information Technology literacy. Tamil Nadu government's free laptop scheme was launched on September 15th, 2011[8] by Tamil Nadu Chief Minister J Jayalalithaa. The ambitious free laptop scheme of the Tamil Nadu government, in which 68 lakh laptops are to be distributed. The scheme, the first-of-its-kind in the country, would be issued to students of government-aided higher secondary schools, arts and science colleges, engineering and polytechnic colleges. The laptops were loaded with so much educational content. But many students did not know how to access them.
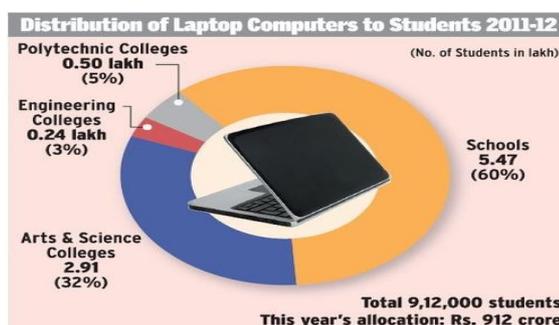
Fig . 2 Distribution of Laptops to students in Tamilnadu

This is probably one of the largest unconventional ICT interventions in education in India. The traditional approach would have been to give the laptops to children in schools. In the Indian context, with tightly controlled access to anything in school, that would have probably limited the use of the laptops by the students to a computer period under the watchful eye of a teacher or a computer operator. The Tamil Nadu Government's scheme takes a diametrically opposite approach and puts the laptops directly in the hands of the end users, with no role for the institution. The laptops became tools for learning and for exploration for students in classroom and outside. The free laptop scheme could open up a whole new world of knowledge-based opportunities to a generation of students from remote and rural areas who hope to do well in higher education.

The following map shows the region of Tamilnadu in India.
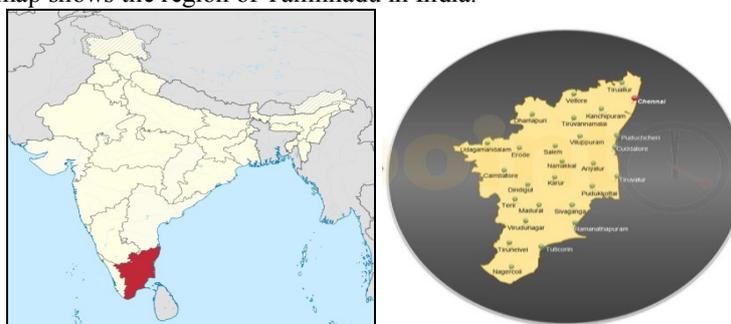
Fig..3 Map highlighting Tamilnadu in India

IX. Gandhigram experiment in Science education for Rural Development

The Gandhigram Rural Institute (GRI) was founded in 1956, with undying faith and deep devotion to Mahatma Gandhi's revolutionary concept of '*Nai Talim*'system of education. GRI has developed academic programmes in Rural Development, Rural Economics and extension education, Rural Oriented Sciences, Cooperation, Development Administration, Rural Sociology, English and Communicative Studies, Tamil and Indian Languages, Agriculture and animal husbandry; and Health and Sanitation. The institute has developed

into a towering educational complex comprising of seven academic faculties with 24 departments and 7 centres. Under the faculty of Rural oriented sciences, undergraduate programmes in Mathematics, Physics, Chemistry, Home science, agriculture and Post graduate programmes in Mathematics, Physics, Chemistry, Biology, Home science and Diary science are offered by the institute.

The students were well trained in the science subjects using the technology enabled education, all the science classes are integrated with the corresponding practical experiments in the laboratory, which will enhance their understanding capacity in learning science. Fully equipped smart classrooms are used for the instruction, and the students are having their own computer centre laboratories to utilise for learning with free access to internet facility, this motivates the students to engage themselves in the learning process. E-content development programmes were conducted periodically for the benefit of the university teachers. The teachers are well trained in the development of e-content material for their subjects, in the university e-content laboratory. This makes the teaching of science more interactive and lively. In addition, the students have to undergo the Village Placement Programme (VPP) and participate in the rural extension activities. During these extension activities the students will give training to the rural village school teachers by conducting the laboratory experiments and use of computers for online transaction.

Maximum numbers of the students who get enrolled in this institute are from the rural areas and the institute has student adventure club, trucking club and a cell for culture and arts. Life skill education, soft skills are also imparted to students. Environmental study is offered as compulsory paper for all the undergraduate students. 'Gandhi in Everyday life' is offered as a special course for undergraduate students and 'Gandhian way of Management' is offered for the post graduate students to propagate and inculcate the Gandhian views among the rural youth. The academic programmes in the science courses are integrated with teacher education programme in order to train to attain proficiency for teaching science in the rural schools.

X. Nexus of Teaching and Research

Research is the major component of all education. It imparts excitement and dynamism to educational process. There is a symbiotic relationship between research and teaching. Research contributes to theory and practice of science education resulting in innovations and reforms in the existing system of higher education. Teaching process leads research in education, thorough various research in the field of science many innovations and discoveries has been conceded. Extension is the major component for disseminating the research outcomes to the welfare of the society. Through extension activities the research outcomes can be carried to offer an opportunity to the students to understand the different facets of the community. Extension enables the students to relate and comprehend classroom learning to field realities, share developmental information with the common people. Extension paves a way to inculcate scientific values and responsibilities among the students.

XI. Conclusion

Technology is not new to education. Many new technologies are interactive, making it easier to create environments in which students can learn by doing, receive feedback, and continually refine their understanding and build new knowledge. Access to the internet gives unprecedented opportunities in terms of the availability of material and resources for teaching and research. The incorporation of important ICT components can facilitate curricular reforms and strengthen the teaching learning process especially at university level. ICT is treated as a subject rather than an operational tool that can be used for instructional purposes of various subjects. Recent discourses however indicate that future curriculum reviews may consider ICT a full-fledged mainstreaming process. Teacher education programmes have a critical role to provide the necessary leadership in adapting pedagogical innovations and ICT in their pre-service and in-service teacher education programmes. Moreover, the universities must also take the lead in extending the ICT expertise to classroom teaching and to enhance the standard and quality of education in India.

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