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# Synthetic Teaching – Learning Model: A Contextualized Study

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**Abstract**

The paper aims at institutionalizing instructional technology with a view to improving the quality of education. The conceptual framework developed in this paper reviews the existing status of training programs in light of the suggested initiatives of education sectors reforms (Ministry of Education, Government of Pakistan -August-2003). It has been argued that major purpose of imparting professional training to teachers and administrators should be directed towards improvement of quality of education. In stating the problem the malaise underlining the teaching-learning process has been identified as a core issue. The teaching-learning process which is the hallmark of quality of education has been stalled because of the limitations inherent in the current education system. Essentially, epistemological model presently used treats the student as a passive learner. The rise of constructivist approach on which the current learning theory has been constructed emphasizes the role of student as an active learner and the teacher as a facilitator. The new learning process being employed in USA relies on the assumption that the learner retains 20% of what he sees, 40% of what he sees and hears and 80% on what he sees, hears and experiences practically. This aspect has been fortified through the integration of tools of technology in education. The paper identifies the paradigm shift needed from directed model (Passive learner) to constructivist model (Active learner). Further, it has been noted that immediate transformation, with the mindset prevailing amongst the teachers of Pakistan, can't be applied as such. Accordingly, taking all aspects into consideration a synthetic model has been designed for application in Pakistan. This model has the special dialectical advantage of combining semiotic model with constructivist approach using tools of information technology to the extent possible. The synthetic model presented in this paper assumes (a) that full utilization of the abilities of existing teachers is to be made (b) that course content and curriculum of Education Colleges/Institutes have to be altered to accommodate the constructivist approach (c) that in-service teachers have to go through a cycle of training for using the tools of technology in the teaching-learning process (d) that technology based resource rooms are to be established in educational institutions (e) that existing curriculum is to be transformed into model lesson

plans for training of teachers , (f) that partnership of public and private sectors in the implementation process will be needed .

## INTRODUCTION

For a long time now, we have been using the slogan of "quality of education" simply as a cliché. No substantial effort whatsoever has been made in any of the policy documents to trace the malaise which has eroded the quality of our instructional programs at all levels of education. Nor has there been any attempt to suggest ways and means for eliminating the weaknesses of the system. This state of affairs has persisted for about five decades.

We are passing through a period of convulsive change. This is evident in all walks of life. Agricultural revolution, followed by industrial revolution has now culminated in technological revolution led by information sciences. Margaret Mead, a famous sociologist once wrote "no one will live in the world in which he is born and no one will die in the world in which he lived." Both time and space are shrinking. Education is no exception and is confronted with serious challenges. The present day unprecedented scientific activity clearly warrants the preparation of a different kind of manpower, *albeit* constructed on a strong epistemological base. To be able to do so one has to look deep into the core of the education system, that is, the learning and teaching process. This concept paper attempts to address this question succinctly so that a sustainable, enriched learning-teaching process for improving the quality of education can be formulated. The task is difficult, but achievable. We must realize that we are standing in the beginning of a pathway of progress, staring at the glittering cycle of advancement, several milestones away. How then, do we proceed?

We have picked up the learning and teaching process as a central theme in the ambit of quality of education. This needs to be elaborated before we proceed further. The process has three subsets: a) Curriculum, b) Text Books, and c) the Teacher. Of course, these subsets operate in the milieu of class room environment which by itself figures prominently in the measure of quality.

The teacher and learner are two inseparable entities. In the present educational training in Pakistan, the teacher is essentially trained to impart instruction within the frame-work of curricular content, supported by textbook materials (Kazilibash, 1998). In laboratory based subjects (that is the sciences) the theoretical information is corroborated with practical work for verifying the concepts. In this process, the learning model used in our education system,

treats the student as a passive subject. This scheme of learning and teaching has a number of limitations as it does not promote critical thinking skills in the students (Hoodbhoy, 2004).

## LEARNING THEORIES

### Epistemological models

In view of the above, we consider it necessary to bring into focus three epistemological models which have evolved over the years. First, the behaviorist model: which states that "learning is a change of the learner's ability to identify an apparent stimulus for the desired behavior and extinguish the undesirable behavior" (Skinner's stimulus–response model). In this model, the student remains a passive learner which is the present scenario in the education system in Pakistan. Second, the cognitive model, which is presented by Jean Piaget, lays emphasis on the mental capacity of the learner. In its application, instruction is organized into packets of learning that are in conformity with the learner's cognitive ability. Third, the constructivist learning model, which inherently is an extension of the positivist philosophy leavened with Jean Piaget's Cognitive theory. The constructivist learning model requires that a learner forms a hypothesis, based on observation of varied cases through original creative thought or an interactive process (Elliott, Kratochwill, Littlefield, 1996).

### Learning and mental processes

In the three models mentioned earlier, the concept of learning is a common objective, in addition to another common denominator. The common denominator lies in the exercise of mental processes, irrespective of the fact whether learning is passive or active (behaviorist, cognitive and constructivist). To elaborate further on this, the merit of each of these learning processes is compared in the following table:

**TABLE 1: COMPARATIVE MERITS OF LEARNING THEORIES**

| THEORIST | THEORY FACTS | DIRECTED OR CONSTRUCTIVIST |
|---|---|---|
| B.F. Skinner | • Operant conditioning<br>• Cause and effect relationships<br>• Positive, negative, and punishment reinforcement | Behaviorist /Directed Model |
| John Dewey | • Education is growth<br>• Learning should be 'hands on'<br>• Education should be integrated<br>• Education should be connected to life | Constructivist Model |
| Lev Vygotsky | • Cognitive development is related to and based on social development<br>• Individual culture effects learning<br>• Instruction should be based on child's development and experiences (scaffolding) | Cognitive /Constructivist Model |
| Jean Piaget | • Four stages of cognitive development<br>• Assimilation vs. accommodation | Cognitive /Constructivist Model |
| Jerome Bruner | • Learning through discovery<br>• Three stages of cognitive development<br>• Six indicators of cognitive growth or development | Constructivist Model |
| Seymour Papert | • Use technology in context of traditional teaching methods<br>• Developed Logo (computer program) to enhance children's learning with technology | Constructivist Model |
| Howard Gardner | • Multiple intelligences<br>• Allows each student to learn and contribute to the learning experience | Constructivist Model |
| Gagné | • Translated theorists principals<br>• Provided guidelines for teachers to follow | Directed Model |

It may be noted from the above table that in the last two decades, the constructivist model has dominated the learning-teaching processes as has been promoted by the cognitive path of Dewey and Piaget. Seymour Papert, Jerome Burner and Howard Gardner have further fortified the constructivist model, in various forms, which was originally proposed by L.S. Vygotsky and Jean Piaget (Woolfolk, 1998). For ease of discussion we are summarizing the characteristics of the *directed or behaviorist model* and the *constructivist model* in Table 2.

**TABLE 2: WHAT DOES DIRECTED AND CONSTRUCTIVIST MODEL MEAN**

| DIRECTED MODEL | CONSTRUCTIVIST MODEL |
|---|---|
| • Teaching using sequential methods<br>• Prepare tests derived from skills learned<br>• Stress individualized work over group work<br>• Traditional methods by lectures, worksheets and tests | • Learn through self- experimentation<br>• Pursue global goals that specify general abilities<br>• Focus more on group work<br>• Alternative learning: portfolios, open-ended questions, research, etc. |

## PLANNING EDUCATION REFORMS FOR FUTURE

### Rapid global changes

Rapid global changes are taking place and the education system needs to keep pace with these changes. It is only through education that the workforce will acquire the skills required to deal with the rapid changes in the world. The required skills for the information age need to be taken into consideration by policy makers in Pakistan in order to improve the quality of education. (Private Sector to help in computer literacy plan, 2001). It is becoming increasingly obvious that the constructivist model is best suited for facilitating the learning process. However, care has to be taken in view of cultural diversity prevailing in developing countries (Burbules & Callister, 2000).

**Rise of the constructivist model**

The rise of the constructivist model is essentially due to the advancement of information technology and its integration into daily life. Information technology tools are being integrated into the educational programs in almost all the western countries, specially, the United States of America. The International Society for Technology in Education (ISTE-www.iste.org) is providing wealth of information through its project: National Education Technology Standards Project (NETS). Same is the case with National ICT program of the United Kingdom.

Before we proceed further, we have to examine in some detail the constructivist model and its implications, if it is to be applied to the education system in Pakistan. It is well known to us that our instructional methodology relies heavily on teacher-centered approaches, treating students as passive learners (Hoodbhoy, 2004). Our instructional methodology has not kept pace either with the cognitive approach or the interactive method. This is the crux of the problem. It clearly warrants that with the dawn of a new era of educational reforms, teacher-centered methodology is altered to the extent that tools of technology are integrated into education (Coe, 1996).

After presenting the characteristics of various learning theories, we now proceed to examine in some detail, the prevailing learning-teaching practices in Pakistan (Hoodbhoy, 1998). We will, as well, examine its limitations in terms of the root cause of the deteriorating quality of education, and then, develop a learning model based on Neo-Piagetian-Constructivist design for application in Pakistan.

## CURRENT STATUS OF TEACHING-LEARNING IN PAKISTAN (DIRECTED LEARNING BEHAVIORIST)

In section 1.2, we have indicated that our curriculum delivery is highly teacher centered, treating learner as a passive subject. This, essentially**,** conforms to the behaviorist design (Table 2), and is in stark contrast to the cognitive constructivist theory of learning. Examined critically, behavioral psychologists are interested in the study of changes which manifest in behavior as opposed to mental states. Learning is conceived as a process which conditions observable behavior as a result of reinforcement of an individual response to events (stimuli) that occur in the environment (Eggen, Kauchak, Harder, 1979). The mind is seen as an empty vessel, a *Tabula Rasa* to be filled, or as a mirror reflecting reality. In this process, the student is required to accumulate knowledge of the natural world as transmitted by the teacher without questioning. Therefore, it relies

on a transmission, instructionist approach which is largely passive, teacher directed and controlled. (Objectivist epistemology). Accordingly, the objectivist believes in the existence of reliable knowledge as being "*out there*" - the phenomenal world which is to be transmitted to the learner. The goal of the learner is to gain knowledge, and that of the educators is to transmit the knowledge. Learning, therefore, consists of assimilating objective realities as transmitted by the teacher. The learner is simply made to replicate the content and structure this into his/her thinking.

This approach has resulted in somewhat stereotyped portrayal of teaching and learning. Thereby, stalling the learning process, and consequently, the quality of education, resulting in the need for immediate and radical educational reforms. In essence, to a large extent, we have to abandon the classical approach which is driven by "teacher talk" and is heavily dependent on textbooks, as the only means of understanding the structure of the course (Jalalzai, 2005). We also have to disregard the idea that there is a fixed world of knowledge which the student must come to know, by dividing information into parts and then build the same, into a whole concept. This approach leaves little room for student initiated questions and for independent thought or interaction between students. The goal of the learner in this scheme, at best, is to regurgitate the accepted explanation of the course content expostulated by the teacher. The current model of teaching and learning is represented in Figure 1and  summarizes the mechanism and the limitations of this approach:

**FIGURE – 1: CURRENT MODEL OF TEACHING-LEARNING IN PAKISTAN**

## Some limitations of the behaviorist model are listed below:

***Learner is a tabula rasa; Learner is passive; Learners' task is to accumulate knowledge of fixed objective reality; Teacher is simply a transmitter of information; Learning is only an assimilating process of objective reality; Teachers interpret events for students; Learner is merely to replicate the contents in his thinking; Cognitive processes are not catalyzed; Learner is not exposed to the thoughts associated with the information provided by the teacher*** (Hoodbhoy, 2004)**.**

These limitations are topped with inherent constraints in our system, for example; ***teacher absenteeism; inadequate school environment; ill prepared teachers; de-linked curricula; badly written and shabbily printed textbooks; defective assessment procedure; lack of accountability; little understanding of the educators about the importance of integrating technology in education; a flawed planning process; and much more***(Jalalzai, 2005)**.**

With these ills prevailing in the system there is no chance for the education system in Pakistan to make headway in preparing manpower of acceptable quality. The rapidity with which scientific and technological knowledge is expanding demands new and pragmatic initiatives. Certainly, a system which doesn't promote creative thinking is of no use for a nation facing global challenges in the development of a strong knowledge base.

## ALTERNATE LEARNING SCHEME (CONSTRUCTIVIST, COGNITIVE)

We now turn to the alternate learning design which is attracting the attention of educators globally (Aldrich, Rogers & Scaife, 1998; Coe & O'Neill, 1999; Jones & Moreland, 2003). This reflects a major paradigm shift from the behaviorist model. We have already noted that behaviorism emphasizes observable external behavior and, as such, avoid reference to meaning, representation and thought. In contrast, the alternate method we are describing now, that is constructivism, takes a more cognitive approach. This subtle difference has profound implications for all aspects of a theory of learning. The way in which knowledge is conceived and acquired, the types of knowledge, skills and activities emphasized , the role of the learner and the teacher, and, among others, how goals are established : all these factors are articulated in the constructivist perspective. Over the last two decades several variants of constructivist design have emerged on the basis of intense research activities. Yet, for our purposes we will only rely on those elements of

constructivist design which have been commonly agreed and which have a considerable merit for application in Pakistan.

In the constructivist design there is a general agreement, for example on the role of teacher and the learner .The teacher is conceived to play the role of "midwife in the birth of understanding" as opposed to being a "mechanics of knowledge transfer" (Von Glasersfelds, 1995). ***The role of a teacher is not to dispense knowledge but to provide students with opportunities and incentives to build it up (Von Glasersfelds, 1996). Teachers are described as "guides" and Learner as "sense makers". In Greene's (1995) view, teachers are coordinators, facilitators, course advisors, tutors or coaches. These aspects of constructivism lead us further to analyze: a) The learning cycle, b) the role of the teacher and, c) the role of the student. In addition, it seems necessary for quality assurance to set norms and standards for teachers and students if technology is to be integrated in education.***

## LEARNING CYCLE

In the USA where constructivist approach has taken deep roots in educational system, the learning cycle is an established planning method. It is an easy and useful process for creating opportunities to learn in particular, science subjects. The cycle envisaged by A. W. Lorsbach (2002) but partially modified is reproduced below.

**FIGURE – 2: LEARNING CYCLE**

It may be seen from the above diagram that the six elements include: engage equipment, explore, explain, extend and evaluate, all converge on the learning process (L). The teacher performs the task of ***engagement*** in order to create interest and curiosity; raises questions and listens to responses of students that will give the teacher an idea of what students already know.In the ***exploration*** part, the students are given opportunity to work together without direct instructions from the teacher. The teacher acts as a facilitator and observer. According to Piaget's theory, this is the time of disequilibrium, and *a priori* requires his/hers familiarity with the use of technology in education. This skill provides opportunity for students to test predictions and hypotheses or they may be able to form new hypotheses. The students may then discuss the results of their observations with the teacher. In the ***explain*** mode, students are encouraged to explain concepts in their own words, clarify other students' explanations, ask for evidences and listen critically to one another's explanation and those of the teacher. Students should use the skills of observation and recording before they interpret and give their explanations. In the ***extend*** phase students should apply concepts and skills in new (but similar) situations. Teacher may thus, enable the students to experience the possibility of alternate explanations of the

data presented by them. ***Evaluation*** takes place through out the learning experiences. Teacher may observe students knowledge and skills, application of new concepts and a change in their thinking processes. Students may also assess their own learning. Open ended questions may be asked and answers may be sought from the observations and evidences already obtained by the students. Such questions may be framed which may encourage future investigations.

## THE ROLE OF TEACHERS

In order to understand the role of teacher in the constructivist design, it is necessary that both the radical and social perspective of constructivism are fully understood (Elliott, Kratochwill, Littlefield & Travers, 1996). These perspectives are related to the following:

- *Knowledge is physically constructed by learners who are involved in active learning;*
- *Knowledge is symbolically constructed by learners who are making their own representation of action;*
- *Knowledge is socially constructed by learners who convey their meaning to others;*
- *Knowledge is theoretically constructed by learners who try to explain things they don't completely understand.*

In addition to the above, the teacher should understand that the learners are not passive or incidental. They are involved in an active process in which they construct their understanding out of their own experiences. The learners construct knowledge through experience of the physical world and social interactions. Learning involves linking new ideas with prior knowledge. Learning is not only a process of accumulation and revision of ideas; it may involve radical reorganization of ideas. Invariably, the learners define their own goal and control their own learning (Eggen, Kauchak & Harder, 1979). The learners may accept and assimilate the constructivist meaning or may ultimately reject the same. Such meaning may be shared by many students or may be unique to an individual.

In this perspective of constructivists, today's classroom teachers must be prepared to provide technology supported learning opportunities to the students. They should be prepared to use technology and know how technology can support students' learning. Teachers must be prepared to empower students with the advantages which technology can bring. Classrooms, both real and virtual, must have teachers who are equipped with technology resources and skills, and who can effectively teach the necessary subject

matter (content) while incorporating technology concepts and skills (Centre for Educational Research and Innovation, 1986). Real-world connection, primary source material, sophisticated data gathering and analysis tools are only few of the resources that enable teachers to provide the learner some unimaginable opportunities for conceptual understanding.

Traditional educational practices no longer provide prospective teachers with the necessary constructivist skills. Yet, they must be able to survive economically in today's work place. For this, teachers must pass through a new technology based learning cycle (Dool & Kirschner, 2003; Faseyitan, Njock & Hirschbuhl, 1996). Only then they shall be able to teach students to apply strategies for solving problems and to use appropriate tools for learning, collaborating and communicating. The following chart taken from NETS represents traditional approaches to learning and corresponding strategies often associated with new learning environment. These new learning environments should also be established in teacher preparation programs (pre-service & in-service).

**TABLE – 3: ESTABLISHING NEW LEARNING ENVIRONMENTS INCORPORATING NEW STRATEGIES**

| Traditional Learning Environment | New Learning Environments |
|---|---|
| Teachers –Centered Instructions | Students- Centered Learning |
| Single Sense Stimulation | Multi-Sensory Stimulation |
| Single Path Progression | Multi-Path Progression |
| Single Media | Multimedia |
| Isolated Work | Collaborative Work |
| Information Delivery | Information Exchange |
| Passive Learning | Active Inquiry Based Learning |
| Factual Knowledge- Based Learning | Critical Thinking |
| Reactive Response | Proactive / Planned Action |
| Isolated Artificial Context | Authentic, Real World Context |

Obviously, if we intend to achieve the above transformation in teaching and learning, then, the major task would be the training of pre-service and in-service teachers in line with the constructivist thought and practice.

## THE ROLE OF STUDENTS

To live, learn and work successfully in an increasingly complex and information–rich society, students must use technology effectively (Draper, Brown, Henderson & McAteer, 1996). Within a sound educational setting, technology can enable students to become:

- Capable information technology users
- Information seekers, analyzers, and evaluators
- Problem solvers and decision makers
- Creative and effective users of productivity tools
- Communicators, collaborators, publishers, and producers
- Informed and responsible citizens
- Capable of understanding the ethos of technology in their own cultural settings

The type of student needed in new millennium, and who is able to confront the global challenges, must be able to follow the educational process constructed on the edifice of new technology. It is only through ongoing use of technology in the educational process that the students can be empowered to achieve technology accelerated learning capabilities. This can happen only through well trained teachers and classroom environment, conducive to the use of technology in education (Kleiman, 1984).

## SYNTHETIC MODEL OF LEARNING FOR PAKISTAN

We have reviewed the current status of various learning theories in the preceding paragraphs, *vis-à-vis* the role of the teacher and the student. After examining various research studies carried out on this subject, we have come to the conclusion that the cognitive theory of Piaget as further fortified by constructivists (Neo-Piagetian) is the theory of choice for delivering curriculum to students of the new millennium.

Given the existing constraints prevailing in the country, it doesn't seem possible to apply the constructivist model as such to Pakistani education system (Hoodbhoy, 2004; Jalalzai, 2005). Presently, the formal system of education is fully subservient to the directed model of learning in which instruction is teacher centered. The student only plays a passive role. In-service and pre-service teachers are least prepared for use of technology in education (Shaikh, 2004a; 2004b). The classroom environment is grossly inadequate. The funds are limited. Research studies on the use of technology in education in our

context are limited. There is no established institution in the country to undertake this task. The existing curriculum wings with federal and provincial ministries are unaware of the advances made in this regard. Under the circumstances the only path to reformation of education process lies in adopting a model of learning which utilizes the existing capabilities of teachers, further strengthened with constructivist approaches for application of technology in education (Brady, 1985; Joyce, Weil & Calhoun, 2000).We have used this approach to develop a synthetic model of learning which is described below. In formulating the synthetic model, we have taken into consideration the relevant and effective approaches of the major theories of learning, that is, the behaviorist, the cognitive and the constructivist. We were guided to do so because of the prevailing constrains, and for making the teaching-learning process more practical, pragmatic and cost effective.

The behaviorist model though structured through experimentation on animals (Skinner) relies on "stimulus-response". This part of behaviorist theory cannot be ignored in any design of teaching and learning. The learning of a newborn child, for example, is directly related to physical stimuli impinging upon his neural network from environment. This process continues through out life. This axiomatic approach of behaviorists is the mainstay of teacher centered curriculum delivery in Pakistan. This is partly reminiscent of the Socratic- Platonic educational philosophy.

Piaget's cognitive model approaches learning process on a more scientific basis, which has its roots in human psychology and natural cognitive abilities through evolutionary associations of neurons. The various stages assumed in cognitive development are age dependent. For example, four stages have been identified in linear cognitive progression. First: age, birth to 2 years, in which the cognitive part is essentially sensory-motor. The child through physical interaction with his environment builds his own concepts about reality. Second: age, 2-7, is a preoperational stage in which the *tabula rasa* gradually becomes a subject of physical permanence through association of concepts with reality. Third: age, 7-11, the concrete stage in which there is a rapid increase in cognitive ability supported by identification of objects, memory and expression through language. Finally the fourth stage, age 11-15, presents a formal operational stage in which he begins to appreciate the process of the external world and develops through a varying extent the analytical ability. It has been recommended that curriculum should be structured in conformity with the four stages of cognitive development (Woolfolk, 1998).

There is, however, a caveat in Piaget's cognitive plan. This caveat relates to the cognitive abilities allocated to various age groups. With the advancement of technology, past the

Piagetian period, the present day child is exposed to new stimuli of information through audio-video media. This exposure has brought about a major shift in the age related cognitive processes of the child. This in particular is the theme on which the constructivist structure is designed. Accordingly, the constructivists have developed a scheme of learning in which child from the early stage of development is exposed to tools of technology. According to constructivists the technology tools enable the student to construct his/her own ideas about the concepts contained in the course content and sharpen his/her creative abilities. It is through this process that he/she begins to see the world not as a static source of knowledge but as a contributor to the change of world around him/her (Coe & O'Neill, 1995; Eggen, Kauchack & Harder, 1979).

In preparing the synthetic model, we have synthesized the useful parts of the three learning theories in order to achieve operational ease and for immediate and maximum utilization of the abilities of our existing teachers. The three important features taken from these theories are:

- direct student–teacher interaction which to a reasonable extent will be teacher centered (directed teaching , stimulus response )
- cognitive abilities as envisaged by Piaget but accelerated through exposure to information provided by multimedia
- the use of technology in education as propounded by the constructivist in the process of delivery of curriculum

Based on these three components the proposed synthetic model is schematically shown in figure 3.

## Features of this model are:

Teacher-centered instruction, but, considering the student as active participants. This is shown as direct teacher –student interaction

Teacher-centered instruction based on clarification of concepts through the use of hypermedia . This is shown as teacher-instrument interaction. In this part of the scheme the explanation offered for any concept are to be coupled with various unsolved problems for which the students will seek solution. Such materials will be available in the Server during and beyond the time of the class, for example, in the resources center.

The use of tools of technology by the student. This is student-technology interaction related to the course content, problem solving or new contents beyond the course out line (web-based)

The above assumptions take into consideration the fact that our teacher has full mastery over course contents.

No change in curriculum is envisaged at this stage. Curriculum development is an evolutionary process depending upon expansion of knowledge and societal needs. This will take its own course

In order to achieve positive results in terms of quality of education, the technology tools listed below must be associated with the teaching-learning process :

a) *Hardware in the form of computers*
b) *Various software's*
c) *Printer*
d) *Resource room equipped with all the material listed for use by students at various hours of school day*
e) *Multimedia (optional)*
f) *Overhead projector*
g) *Internet connection*
h) *Intranet*

The assessment scheme in the synthetic model is built into the student-teacher interaction based on observations by teachers during group discussion, individual problem solving, assignments and to a limited extent self assessment.

## ESTABLISHING NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS FOR TEACHERS

On this count, excellent information has been provided in the document prepared by NETS "NETS For Teachers–Preparing Teachers to Use Technology" www.iste.org the same is reproduced below for ease of further discussion in relevance to our need.

- Mastery over course content
- Technology operation and concepts
- Planning and designing learning environment and experiences
- Teaching-learning and the curriculum
- Lesson preparation
- Assessment and evaluation
- Productivity and professional practice and
- Social, ethical and human issues

All classroom teachers should be prepared to meet the following standards and performance indicators.

TECHNOLOGY OPERATIONS AND CONCEPTS

Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:

a. demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE NETS for Students).
b. demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

PLANNING AND DESIGNING LEARNING ENVIRONMENTS AND EXPERIENCES

Teachers plan and design effective learning environments and experiences supported by technology. Teachers:

a. design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
b. applies current research on teaching and learning with technology when planning learning environments and experiences.
c. identify and locates technology resources and evaluates them for accuracy and suitability.
d. plan for the management of technology resources within the context of learning activities.
e. plan strategies to manage student learning in a technology-enhanced environment.

TEACHING, LEARNING, AND THE CURRICULUM

Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning. Teachers:

a. facilitates technology-enhanced experiences that address content standards and student technology standards.
b. use technology to support learner-centered strategies that address the diverse needs of students.
c. apply technology to develop students' higher order skills and creativity.
d. manage student learning activities in a technology-enhanced environment.

ASSESSMENT AND EVALUATION

Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:

a. apply technology in assessing student learning of subject matter using a variety of assessment techniques.

b. use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.
c. apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication , and productivity.

PRODUCTIVITY AND PROFESSIONAL PRACTICE

Teachers use technology to enhance their productivity and professional practice. Teachers:

a. use technology resources to engage in ongoing professional development and lifelong learning.
b. continually evaluate and reflects on professional practice to make informed decisions regarding the use of technology in support of student learning.
c. apply technology to increase productivity.
d. use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning.

SOCIAL, ETHICAL, LEGAL, AND HUMAN ISSUES

Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PK–12 schools and apply that understanding in practice. Teachers:

a. model and teach legal and ethical practice related to technology use.
b. apply technology resources to enable and empower learners with diverse backgrounds, characteristics, and abilities.
c. identify and uses technology resources that affirm diversity.
d. promote safe and healthy use of technology resources.
e. facilitate equitable access to technology resources for all students.

## CONCLUSION

The synthetic model presented in this paper assumes (a) that full utilization of the abilities of existing teachers is to be made (b) that course content and curriculum of Education Colleges/Institutes have to be altered to accommodate the constructivist approach (c) that in-service teachers have to go through a cycle of training for using the tools of technology in the teaching-learning process (d) that technology based resource rooms are to be established in educational institutions (e) that existing curriculum is to be transformed into model lesson plans for training of teachers (this will require constant development in specified institutions, for example, Institute of Learning Sciences), (f) that partnership of public and private sectors in the implementation process will be needed .

Once the concept of introducing this scheme as a major educational reform is accepted, then, a full implementation program with cost analysis and participating institutions can be worked out. However, since many aspects of this strategy are to be debated, it is highly desirable that based on this concept paper a, national conference be held. The participants for this conference are drawn from amongst (a) teachers (b) technologist c) educational administrators (d) educational planners (e) principals of educational colleges (f) curriculum experts from curriculum wings (Provinces, Federals) (g) university professors.

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