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Introducing Design and Technology in School Education: Legitimising Multiple Expressions in Classrooms

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The issue

Indians are manifestly capable of adaptive use of modern technologies. Yet, India consistently rates low on significant technological innovations (World Science Report, 1998). Among the people concerned about the problem, some lament that school curricula disregard the nation's cultural heritage of technology productions, and others that education fails to empower the country's populace with such productions (Kothari, 2001).

Technological innovations involve multidisciplinary perspectives and multiple skills. Appropriate training beginning at the school level is the key to creating experts and citizens capable of innovations. Indian school education with its narrowly defined curricular subjects includes little problem solving, and aims at mere technological literacy among students. The classroom communication is severely constrained by content and language of the textbooks. This education also alienates a majority of students from their environments, suppresses their natural and culturally rich modes of expression and stifles local technological innovations. Enriching school curricula with explicit opportunities for multiple expression modes valid in a variety of classroom contexts will not only help meet the need for future technology innovators, but could also redefine the role of school education itself, and potentially the cultural identity of the society. This premise drives the programme of design and technology in school education at the Homi Bhabha Centre for Science Education on technology education at middle school level.

Alternate positions

The classroom context is often thought to be a given in any particular educational set-up. Cognitive studies drawing on the work of Vygotsky and Piaget, and evidences from recent anthropological studies indicate that the context of learning, including peers, teacher, classroom, school and the social setting, plays a crucial role in the acquisition of knowledge and competencies (Brown and Duguid, 1993). Important inputs for reshaping the context of learning come from research in situated cognition (Norman, 1993; Clancey, 1995) and situated learning (Wenger, 1993; Rogoff, 1998). These studies present the acquisition of representations of knowledge, procedures and competencies as necessarily determined by the context in which they happen.

Recent studies have unearthed that the social differences that exist among different cultures affect the nature of their cognitive processes (Nisbet et al, 2001). The history of engineering drawings demonstrates that the modelling methods available to designers do directly affect the potential content of their thoughts (Baynes, 1992). Design and technology activities provide the discourse space and cultural environment that support the use and learning of technology-specific language.

The problems of mismatch between culture, human developmental needs and education are exacerbated in the teaching of science and technology through nation-wide uniform curricular frameworks. These curricula neither explicitly connect with local contexts nor value local knowledge and varied ways of expressing (Chunawala et al, 1996; Natarajan et al, 1996).

Design and technology activities not only draw upon the knowledge of key concepts characteristic of technology – concepts traditionally taught within other disciplines like the sciences and the arts – but also need a variety of skills. Besides, the activities integrate aspects of affect (wants, desires and aesthetics) and judgements (making strategic alliances, choosing materials and evaluating products). Thus, technological activities go beyond addressing episteme (knowledge) and techné (skill), and include phronesis (practical wisdom) (Dunne, 1993).

Our framework

In multi-cultural India, design and technology tasks that evolve within the classrooms, negotiated by students and guided by sensitive teachers, can help connect with the immediate social context, and make use of multiple expressions and appropriate technical tools. The introduction in the classroom of the repertoire of expressions within design and technology (D&T) has the potential to legitimise multiple expressions. D&T curriculum can be inclusive rather than an exclusive endeavour for mixed ability students in different cultural settings, and in diverse multicultural classrooms across the country.

The D&T project discussed here addresses the development, of possible classroom situations that engage students in using knowledge, skills (thinking, manual, procedural, artistic, social, etc.) and values (aesthetic, social). It is envisaged as an action research project having several phases. In the completed first phase, a few design and making tasks have been developed through participation in three school settings. The meaning of the task goal set by researchers and the plans for achieving the goals were negotiated among the students – about 20 per school from Std. VI and VII. The 3 schools were set in different socio-cultural and linguistic environments. Diverse strategies and skills are used by students to complete the tasks. Different modes of expression by students – sketching, drawing, model making, verbal and non-verbal negotiations, oral communication and acting out, and writing in point form, descriptions, and poems – have been integrated in the activities involved in the tasks, and these are observed through a variety of data collections methods.

The second phase will appraise the D&T tasks carried out in terms of their educational goals and content. It will also address the socio-cultural and gender appropriateness, and cognitive suitability. In the third phase, additional and complementary D&T tasks will be developed. In this phase, the modules will be carried out during school hours with the help of teachers. The learning package so developed for students of a specific class would make up a *design and technology education module*. In a longer term, the study is expected to lead to the development of a collection of *D&T education modules* for Indian students at the primary and middle school levels.

Contextual answers must be sought for several questions before D&T education can serve its intended purpose. These include level of school education (pre-school to secondary) at which to introduce D&T, the content and pedagogy at each level, and its relation with existing subjects. The potential of appropriately taught D&T to enhance the learning of other subjects, when proven, will serve to support its introduction as a school subject. Considering the large numbers of both students and teachers in the Indian educational system, methods need to be worked out to orient teachers to teach for D&T capability, beyond mere technological literacy. Integrating socio-cultural and equity aspects in D&T practice need to be clearly spelt out and incorporated in the curricula. A few of these issues, especially the diverse modes of expression and socio-cultural differences have been addressed in the first phase of the action-research project. Some of the deeper issues will need continued research in the area.

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Early Exposure of Pre-College Students to Information Technology

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It is known that information technology plays an important role in employment and productivity of current U.S workers and will do so even at a faster rate in years to come. Yet, the exposure of pre-college students to the technology has been very slow. This is even more evident in some of the major city school systems where inadequate facilities, poor infrastructure and ill-trained teachers have contributed to further deterioration of any planned educational activities in this area. This paper highlights a program that was recently instituted by a non-profit organization, in collaboration with local universities and industry partners, to address the problem and expose pre-college students to information technology and related STEM disciplines. The program is based on past research on students' learning through hands-on activities. Preliminary assessment of the program outcomes is presented in the paper.

Objectives and Rationale

There is no doubt that unfamiliarity with information technology (IT) discipline will limit students' educational opportunities and their future economic status (Gannod, 2003; U.S. National Science Board, 2004). This is nowhere more evident than in the U.S. where current data and future projections show that IT will play a crucial role in increasing the nation's productivity and creating a productive workforce.

It is true that more and more U.S. schools are equipped with computers and associated facilities compared to the scenario that existed in the mid-1990 (National Education Association Homesite, 2004). However, the utilization of computer technology has been limited. A recent study of utilization of computer technology in high schools showed that the primary use has been for word processing and Internet access (Gupta and Houtz, 2000). The study also revealed that students seldom use the technology for learning or developing skills in area of programming, information storage, data manipulation and retrieval, web page development and for communicating through graphics. Graphical com-