Design as Drawings: Analyzing Drawings of Middle School Students in Technology Education Tasks

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Objectives

Technology tasks engage its participants in a variety of activities: investigation, planning, designing, modelling, making, and evaluating. The study reported here is a part of the broader goal to develop design and technology education modules that will engage middle school students in the classroom. The sequence of actions closely resemble technology task model that have been used in UK and Australia (Kimbell 1996).

Design is at the core of technology activities (de Vries, 1997). There have been a number of attempts to arrive at a theoretical framework for design (Houkes et al, 2002), and to articulate its methodology and role in collaborative learning contexts (Pieters, 2004). Drawings have several roles in design besides making it explicit. This article focuses on middle school students' evolving drawings as they engage in design activities within 3 different technology tasks developed by us.

Theoretical framework

Cave paintings, cartographers' representations, designs and sketches of cathedrals and bridges, illustrations capturing the details of animal, plants and insect anatomy, all show that humans have always used drawings to communicate their ideas. These productions also reflect their socio-cultural contexts. Drawing has been a creative engagement central to every facet of visual arts (Callaway and Kear, 2001).

This report draws from discussions of technology task as a vehicle for multiple modes of expression, and the situatedness of such tasks (Natarajan, 2004). Several studies provide insights about the implications of drawings in learning. Drawings are instruments of thought and serve to clarify features of an idea (Albarn and Smith, 1977). Drawings have been used to probe psychological states (Serendip, 2004), to elicit ideas of people, and specifically, of students (Mehrotra, 2003; Natarajan et al, 1996; Chunawala and Ladage, 1998).

Despite the rich potential of drawings for learning, these have been neglected in Indian school curricula: introduced at the primary level, disappearing at the secondary school level, except as mere reproductions of scientific drawings, geometry figures or geography maps. As for design drawings, there is little scope for its practice. Attempts to see craft and art as essential for shaping an individual (Gandhi, 1968) have been all but forgotten.

Drawings manifest ideas and intentions in the design of a product – through "rough" sketches, "technical" drawings and "procedural maps". Though limited by students' skills, drawings give a glimpse of students' ideas that may be otherwise difficult to infer from verbal descriptions or actions. Drawings make ideas explicit for negotiation among designers or between designers, makers and users.

Research design

Three technology intervention tasks were planned: making a bag to carry school books, a windmill model to lift weight, and making puppets and staging a puppet show. The duration for each task varied from 10 to 15 hours. About 20-25 students of classes 6 and 7 (age 11-13 years), from each of 3 schools, participated separately in the three technology tasks. They represented 3 *clusters*: Urban English and Marathi medium clusters, and a cluster from a government run residential Marathi medium school for tribal students. Each *cluster* of students worked in 6 groups: 2 mixed groups (2 boys+2 girls), 2 groups of boys and 2 groups of girls. The tasks evolved as the students adapted to them and collaborated with their peers and the researchers to complete each task (Rogoff, 1998).

Each task involved diverse skills, some familiar school experience (drawing, measurements, etc.), and some new skills. Data collection tools included observers' notes, complemented by researchers' comments, audio and video recordings. Communication of design and oral descriptions were rich sources of data. Each group filed their paper-pencil productions: descriptive writings, poems, evaluation sheets, and all drawings. Thus, the three technology tasks provided opportunities for multiple modes of expression.

Some findings

In general, the paper-pencil work of urban Marathi medium groups was neater. They drew tables to represent data and information, and procedural maps, to

relate drawings with their descriptions. They showed more confidence than other groups in putting down their thoughts, as seen from the fewer erasures in their work. Most groups made more than one sketch, and some even made models. The tribal groups were less distracted (more focussed on the task) in all their activities. However, they showed diffidence in producing drawings, and had problems in relating drawings and their descriptions.

Though the initial drawings of objects reflect students' imagination, they also indicate that students are unfamiliar with the rules of 3-dimensional (3D) drawings. There were some improvements in depicting 3D ideas in each subsequent task.

After exposure to aspects of technical drawings, students incorporated these immediately in their productions: showing dimensions of objects by suitably positioned lines and arrows, and writing dimensional values and units. They continued to use these techniques in their later technical drawings as well as in procedural maps, and not in free sketches, showing that they had possibly integrated this *language of technology*.

Urban students' sketches indicated the variety of products envisaged by them. Their designs for bags included different structural (material, shapes, sizes) and decorative (laces, pictures, coloured paper) elements. For the windmill blade, they depicted a variety of components in their drawings (spoon, foil, cardboard, etc.). However, no urban group included aspects of durability and rigidity for this task. While urban English medium groups did not draw or write about their assembly, among the urban Marathi medium groups there were sketches of different ways of assembling components. All the tribal groups used uniformly similar designs, including structural shapes and materials for the windmill task. Differences were seen only in the details of dimensions and decorative elements. Notably, they also showed aspects relating to rigidity. The tribal groups used their textbooks as a resource to come up with very detailed and varied drawings for the characters in the puppet task.

The evolution of students' drawings through the three technology tasks indicates that exposure to design activities in the context of different technology tasks helps students understand the different roles of design. The roles may include preliminary ideas about the object to be made, recognising that there are alternatives, the variety of components and skills needed for their own design, and use of design as a plan for making and coordinating each others' work. The extent to which these roles will be understood will depend on the rich experiences students get through a variety of design and technology tasks.

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