Studying Indian Middle School Students' Attitudes towards Technology

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Understanding students' ideas is a key step towards meaningful learning. Perception and attitudinal studies in education have been used to unravel crucial aspects about a particular issue, concept or an idea. Technology is a construct little explored in the Indian context. The paper reports development of an instrument and study of students' perceptions of technology and attitudes toward it. Some salient findings from the study are reported. The study brings out the influence of urban and rural settings, medium of learning and gender differences on the several items probed. The differences highlight the necessity to incorporate some of the ideas in developing units for technology education. Insights from the study can be channelled to making technology education units more inclusive and interesting.

Introduction

Technology surrounds us and influences our lives in profound ways. It would be impossible to imagine a world without technology. Educational experiences and training in diverse knowledge and skills prepares one to face challenges. Individuals become empowered to modify their environment and meet their needs and desires. Though technology education has been an emerging discipline in many countries across the globe, it is still to establish itself in Indian schools. In such a context unaffected by influence of antecedent disciplines, it would be interesting to know what students' perceive of technology and what attributes they ascribe to technology.

Attitudinal constructs account for and infer patterns of thinking, emotion and action. Attitude is a learned disposition to respond in a consistently favourable or unfavourable manner towards an attitude object (Koballa & Glynn, 2007). The attitude object may be a specific object, institution, person, issue or an event. Hence, an understanding derived from studying students' perceptions of and attitudes towards technology may help in planning and tuning the curricular units to the cognitive levels of students in order to achieve meaningful learning (Ausubel et al., 1978).

Review of Literature

Understanding technology has been of interest to researchers probing students' ideas about science and scientists, the nature of relations between science and technology (Sjøberg, 2002), and linkages between Science-Technology-Society (STS) (Aikenhead et al., 1987). Only in the past two decades, with the emergence of technology education as a discipline in formal schooling, have studies focussed their attention on understanding attitudes towards technology *per se*. Attitudinal studies such as Pupils' Attitudes Towards Technology (PATT), have given useful insights and allowed cross-cultural examination of students' perceptions of technology. Studies in the Indian context, however, have been few and were targeted at post school students (Rajput et al., 1987). Common to all studies is the finding that students have a positive attitude towards technology and associate technology with products such as computers, television and electronic gadgets. Over the years the Indian scenario has undergone considerable changes in a very short span of time due to influx of many technologies that have had an impact on human lifestyles. An appropriate instrument that integrates questions on local contexts and encompasses technology and all its manifestations can be used to probe students' ideas.

Objectives of the Study

The broad objective was to study middle school students' perceptions of and attitudes towards technology as manifested through their responses and the associations they make with objects, activities, knowledge and consequences of technology.

Research Questions

Following questions addressed the broad objective of research and guided the development and analysis in this survey.

- What does the term *technology* mean to students? What ideas, activities, occupations/professions, and consequences/effects do they relate to technology?
- Who do students see as users of technology? What locations do they identify as relating to technology?
- What artefacts and activities do students rate as *low* or *high*? Do they consider some artefacts and activities as not technological?
- What values (attributes) do students associate with technology?
- What kind of school subjects and disciplines of study do students associate with technology?
- What consequences do students perceive of (a) technology in different situations and (b) occasions of their encounters with novel technologies?
- Do socio-cultural factors of students' setting influence their perception of and attitude towards technology?

Methodology

Selection of the sample for survey and development of the instrument happened in an integrated manner. Students from class 8 (average age 13 years) were chosen for the study. This age group marks the end of middle school and students have had an exposure to technology through the media and some skills through school subjects such as drawing, art and craft. By this age, they also have a repertoire of experiences with objects, activities, locations and occupations which they can associate in meaningful ways. They are able to comprehend the questions, make independent judgements, articulate their thoughts and can voice their opinions freely. Besides, numerous studies in different cultural contexts and those specific to technology validate the fact that students of age 13-14 years (8 years of formal schooling) are an appropriate sample for surveying ideas through verbal or written mode.

The criteria for choice of sample needed to be such that issues and concerns covered by the stated objective and the research questions get answered. Hence, three criteria guided the selection of sample: (i) included more than one *socio-economic setting* (rural and urban), (ii) included the two most commonly encountered *media of formal learning* in the State, namely, Marathi and English, and (iii) had a near equal representation of both of the *sexes*.

Sample for the Study

The survey was conducted in two phases: the pilot and the final study. Using the convenience sampling technique, clusters were chosen to satisfy the three criteria. Choice of the pilot sample considered representative samples covering the three criteria, so that difficulties of students from all kinds of contexts and sample types are addressed. A classroom of students in a setting formed a cluster. Relative physical proximity of the school to the researchers' workplace and an existing rapport with the school authorities also influenced the choice of clusters. The sample composition for the pilot and the final study is given in Table 1.

The sample mostly consisted of students from co-educational schools. Attempts were made to reduce gross imbalances between the number of boys and girls, while maintaining a balance in the number of Marathi and English me-

	Pilot							**Final**						
	Marathi			**English**			**Total**	**Marathi**			**English**			**Total**
	G	**B**	**T**	**G**	**B**	**T**	**NT**	**G**	**B**	**T**	**G**	**B**	**T**	**NT**
Rural	20	41	61	0	0	0	61	92	66	158	0	0	0	158
Urban	19	36	55	16	35	51	106	119	112	231	116	139	255	486
Total	39	77	116	16	35	51	167	211	178	389	116	139	255	644

G = Girls, B = Boys, T = Total, NT = Net Total

Table. 1. Sample composition for the pilot and the final study

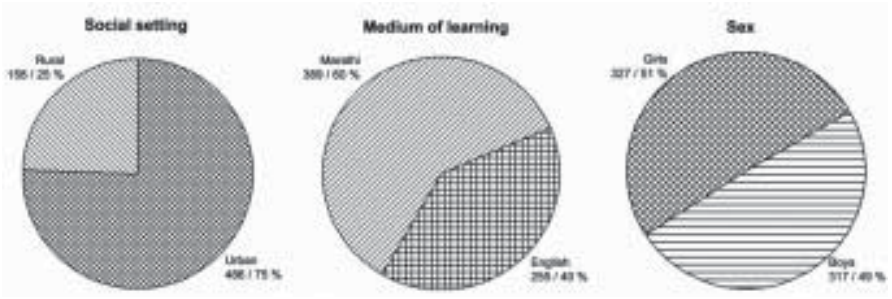

Fig. 1. Sample distribution for the three variables studied

dium students. Hence, two single sex schools in Mumbai and one in the rural region were also chosen. The urban sample had schools with either Marathi, the language of the State of Maharashtra, or English as the medium of learning, while there were no English medium rural (tribal) schools. The rural schools are government-run residential schools called *ashramshaalas,* which cater to the socio-economically deprived tribal students. Sample distribution with respect to three variables studied in the final study is depicted in Figure 1.

Development of the Instrument

The nature of an instrument normally depends on what the researchers want to probe, as well as on the other instruments used earlier or in combination for probing. For example, drawing and writing activities along with a questionnaire were used to probe students' ideas about technology (Rennie & Jarvis, 1995). Aikenhead (1988) analyzed ways of assessing students' beliefs and found out that instruments designed based on empirical findings were more reliable than those deduced from philosophical stances of science educators.

Development of our instrument was initiated with empirical data gathered from a study using posters as a medium to elicit students' ideas about technology (Mehrotra et al., 2003). Though the study revealed some interesting findings, it was limited to urban students and posters are prone to subjective interpretation. Hence, we needed a study that could cut across different settings. Insights from poster study, literature on attitudinal studies and an understanding of philosophy of technology contributed to the development of questionnaire. Characterisation of technology in terms of its manifestations as objects, activities, knowledge and volition (Mitcham, 1994) was used to develop our questionnaire and organize the findings through a scheme depicted in Table 2.

Diverse question formats to avoid monotony and subjective questions to evoke spontaneous ideas were used (de Vaus, 1986). The questionnaire was structured in 5 parts: (a) introduction, with guidelines to students; (b) request for personal information such as, name, age, school and career choices; (c) a free response question (like an idea map) on technology; (d) ratings and other close-ended ques-

Themes	What the theme probed
Technology and students' interests	Relation between technology and students' future plans and ambitions
Technology as objects (artefacts)	Students' ratings of level of technology in each of the given objects
	Association of technology with locations
Technology as activities	Students' ratings of level of technology in each of the given activities
Technology as knowledge	Judgments about prior technological knowledge helping one perform better in given occupations
	Students' choices of occupations as suitable for a male or a female
	Links between technology and knowledge, skills and school subjects
Technology and volition	Consequences and qualities attributed to technology, uses and goals associated with technology at individual and societal levels
	Students' reactions to situations of technological change

Table 2. Themes related to technology that were probed in the survey questionnaire

tions; and (e) a pictorial question. The questionnaire was first developed in English, the language of choice of the researchers and was then translated into Marathi. The questionnaire was pilot tested in June 2002 with students from an urban Marathi, an urban English and a rural Marathi medium school. Administered during school periods, two persons, including at least one of the researchers, were present during each administration. Doubts and difficulties of students were clarified and noted. The data was coded, fed into computer and was screened for problematic items.

Validity and Reliability of the Questionnaire

The questionnaire was evaluated for its validity before the pilot study for the following aspects: (a) overall design of the questionnaire, (b) appropriateness of language in terms of age and context, (c) cognitive and logical validity of content, and (d) clarity of pictures (Creswell, 2002). The expert colleagues, who scrutinised the English and Marathi versions, included researchers in science education, science popularisers, teachers, textbook writers and those having field work and teaching experience among urban and rural students.

The pilot questionnaire was modified taking into account students' difficulties. The number of items in several of the questions was reduced. Pictures of objects like the thresher and vacuum cleaner, which were unclear to urban and rural students, were dropped. Multiple response questions (students could tick more than one of the given item options) that students had found ambiguous were changed to the "agree/ disagree" statement format. Where language of a question was found to be a problem, it was simplified and an example was added.

Reliability of the final questionnaire was tested using *test-retest* method where the same questionnaire was used in the re-test. Two different time intervals were used: a short interval of 14 days between test and retest, and a long interval of a year between the tests as indicated in Table 3.

Interval	Test sample	Interval between successive administrations	Re-test sample	Sample size	Range of correlation coefficients
Short	Class 8	14 days	Class 8	38	0.91 – 0.99
Long	Class 8	1 year	Class 9	30	0.80 – 0.97

Table 3. The test-retest reliability strategy

The greater reliability coefficients in the short-interval case is not simply a case of recall of responses, as can be seen from the high correlation coefficients even after a gap of many months as in the long interval case.

Administration, Data Collection and Coding

The final questionnaire was administered to class 8 students in each of the 11 schools/clusters using the same procedure as in pilot study. Data collection happened during the period July 2002 to November 2003. The responses collected from 644 respondents were coded as numeric codes to generate a variable by case matrix and later fed in a computer. Computational analysis of the data was carried out using Statistical Package for Social Sciences (SPSS) software.

Framework for Analysis

Student responses on various items in the questionnaire were analysed using a set of statistical techniques, which are detailed below.

- Descriptive statistics indicated the trends in students' responses, which helped us make systematic conjectures and test them using inferential tools.
- Chi-square goodness-of-fit was used to judge significance of the differences between frequencies of responses for pairs of nominal categories.
- Chi-square test of significance was used for comparing two variables.
- t-test was used to test for statistical significance between the mean responses from pairs of variables.
- One-way analysis of variance (ANOVA) was used to compare means of sub-groups.

Results and Discussion

The findings from descriptive and inferential analysis have been consolidated and reported in terms of the manifestations of technology schematised in Table 2. Salient findings and some differences on 3 variables, namely Settings (Urban and Rural), Medium of learning (Marathi and English), and Gender (Girls and Boys) have been reported.

Technology and Students' Interests/Ideas

Students' aspirations and interests mirror their attitude towards technology. A question asked students whether they thought they needed to (a) know and (b) use technology to fulfil their future career plans. A large majority (>>80%) of students responded that they need to know as well as use technology. Another question required students to choose among the options of *making* or *buying a toy.* Most students chose "make a toy" when specified as a generic item

rather than "buy" one from the market. This indicated that students exhibit willingness in design and make activities if motivated in an appropriate context. Difference in perceptions surfaced when the sample was compared on the 3 variables of settings, medium and gender. For example, in a situation where three options (make, buy or not interested) were available, a significantly greater proportion of Marathi medium students stated that they would buy a spinning top as compared to the English medium students. Also a significantly greater proportion of girls expressed interest in making a walkie-talkie doll while boys expressed their disinterest in the toy. In an open-ended question students were requested to write *ideas that come to their mind when one sees/hears the word technology.* Urban students ($F = 9.537$, $p < 0.05$) and boys ($F = 10.124$, $p < 0.05$) reported a significantly greater number of ideas as compared to rural students and girls, respectively.

Technology as Artefacts

A question requested students to rate 65 pictures of artefacts (objects) as involving *no, low* or *high technology.* The objects were related to one of the 9 categories: Office, Household, School, Agriculture, Sports, Warfare, Music, Transport and Workplace. As *no technology* was coded 1, *low* was coded 2, and *high technology* was coded 3, the mean code value reflected the level of technology of each item according to the students. Electric/electronic and petroleum fuel-run objects were rated as involving high technology. Sports and domestic kitchen equipments were rated as not involving technology and figured very low on the mean value plot.

Locations embed objects and are hence discussed here. Students were asked whether technology is used in any of the 15 locations listed. Students considered "toilet" as a locale not involving technology. Significant difference ($\div 2 = 118.022$, $df = 2$, $p=0.001$) for "airport" underscored the urban and rural differences. Airport, never found in rural locales and hardly heard about, read or experienced through a visit by rural students, was a concept alien to them. This was reflected in the low mean values by the rural sample. Differences by the medium and gender were also noted for items such as "market" rated higher by English medium students and "factories" rated higher by Marathi medium students. The "home" was rated higher as a location of technology by girls.

Technology as Activities

Much like the question on objects, the question on activities required students to rate a list of 35 activities. Students rated activities requiring formal orientation and specialised manual skills, either in handling or making an artefact as involving *high technology*. These included guarding borders, constructing a house, welding, wiring electrical connections, etc. On the other hand, domestic activities (which in the Indian context are done by females) like sweeping, washing dishes, making *rangoli* (decorative patterns on house floors) and so on, were seen as not involving technology by the students. Interestingly, more girls than boys perceived these domestic activities as involving technology. *Constructing a house* received significantly lower mean values in the rural sample as compared to the urban sample. Rural students live in houses often built by the family with the help of local personnel and materials. On the other hand, urban students who mostly live in multi-storeyed buildings, see professionals like architects, engineers and semi-skilled masons using modern equipment and materials, rated it as *high technology*.

Technology as Knowledge

Students had to state their opinion as *agree, unsure* or *disagree* to 20 occupations indicating whether they perceived prior technological knowledge as a contributor to success in an occupation. Dancer, potter, carpenter and vegetable seller were occupations widely seen as not needing technological knowledge for performing better. The other extreme were occupations such as scientist, computer engineer and doctor. A significantly greater number of rural students felt that technological knowledge may help a teacher perform better.

Another question was a context of two friends, a boy and a girl, seeking the advice of the respondent on the occupations suitable for him/her. A list of 20 occupations was given and for each occupation, students had to indicate its suitability for a girl, a boy or for both. Doctor, teacher and TV news reporter were occupations seen as suitable for both while nurse and cook were seen as suitable exclusively for a girl. Carpenter, mechanic, soldier, potter and mill worker were occupations seen as suitable exclusively for boys. Another situational context probed the assignment of 10 tasks to a girl (Meeta) and a boy (Suresh) so that they could finish all the tasks before they go out to play. Indoor activities such as arranging utensils on shelf, watering plants, dusting the house were assigned to Meeta while tasks such as replacing a fused bulb and outdoor duties such as, bringing grocery, were assigned to Suresh.

Technology and Volition

Volition in philosophy of technology refers to the human desire and drive for engaging in technology. In terms of attitude to technology, volition refers to qualities and con-

sequences attributed to technology. Questions structured to elicit this manifestation were targeted both at the individual and the societal level. On one of questions, students had to respond with either *yes* or *no* response to each of the 10 qualities (polar qualities such as important, unimportant, easy, difficult, etc.). Most students agreed to positive qualities of technology and disagreed to negative qualities. Another question requested students to indicate on a list of 15 effects, whether they *agreed, disagreed* or were *unsure* about an effect attributed to technology. Similar to the trend on the qualities question, students responded in the affirmative for a positive effect and registered their disagreement for a negative effect of technology. These findings concur with findings in other studies where students have been reported to have a positive attitude to technology (de Vries, 2005).

A significantly greater proportion of girls than boys said that technology leads to increase of wealth, gets work done faster and leads to pollution. Compromising self-reliance of the nation due to greater dependence on technology was of concern for boys. Contextual questions that probed students' reactions to situations of introduction of a novel technology revealed students' cautious approach to a new technology. However they were not totally averse to novel technology. Responses to questions about introduction of technologies suggest that students see themselves as consumers of technology rather than being in active control of it.

Conclusions and Implications

The survey revealed that Indian students have a positive attitude towards technology. Students see technology as an important component for fulfilling their future career plans. They express their interest in design and make activities and see technology as having a positive influence on lives.

Students considered power-driven (fuel, electric or electronic), semi-autonomous devices as involving *high technology*. Sports and musical instruments were rated as involving *no* or *low* technology. Locations in which objects rated as *high technology* existed, were locations considered technological as well. Activities involving professional training for making or handling (e.g. wiring electrical connections) were considered as high technology and household activities (e.g. making *rangoli*) were rated as low or not involving technology.

Positive attributes (e.g. important, useful) and consequences (e.g. gets work done faster) were associated with technology more often than negative attributes (unimportant) and consequences (polluting). The study helped gain information about perceptions of technology through the lenses of three variables, namely the setting, medium of learning and gender. Insights from the study helped understand the concept of technology among Indian middle school students, a context little explored.

Insights from this study helped make informed decisions about several aspects of technology education curriculum and classroom practice. The technology education units for middle school students, developed following the study, challenge existing stereotypes of technology and provide opportunities for integrating knowledge and skills from diverse domains of human understanding. For example, the units included activities which were considered as suitable for boys (e.g. working with tools such as hammers, vices, etc) as well as those for girls (e.g. sewing). They included artefacts that challenged common narrow perceptions and conveyed a broader conception of technology. For example, the unit on windmill presents a context of a technological artefact, which is a mechanical device yet does not require fuel for its operation. Another unit on puppetry is an example of a communication system that does not need electronic gadgets but relies on time-tested indigenous modes of social communication. Such an approach may foster a comprehensive and broader understanding of what constitutes technology and its practices.

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