

Punjab Students' Perceptions of Science Topics: Challenging Outcomes from a Front-End Study

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ABSTRACT

This study examined the perceptions of students of Punjab, India regarding their interest in, perceived knowledge of, and perceived importance of various science topics. The study was conducted to help inform the development directions of exhibitions and education programs for the new *Pushpa Gural Science City* (Figure 1). *Science City* is an interactive, hands-on science centre planned to open in the state of Punjab near the city of Jalandhar, in 2005. The outcomes of the study were derived from a survey of 400 participants in the Punjab and provided interesting insights about teenagers' perceptions of what they not only deem to be of interest and importance, but also their perceived levels of knowledge of various science topics. The study revealed some interesting paradoxes in that the topics ranked by participants as most interesting were also ranked as low in perceived importance, and vice versa. Additionally, the study revealed differences in perceptions (between boys and girls) that present challenges to *Science City's* choice of curriculum directions, and also to science educators in the Punjab and India. The study demonstrates that the outcomes of front-end studies are not always clear-cut, and that museums still must ultimately struggle with their own philosophies about the curriculum they display and interpret in the light of the outcomes of front-end studies they commission.

THE STUDY

A consortium comprising AldrichPears Associates¹, IPCS² and The University of British Columbia (based in Vancouver, Canada) worked with *Science City* to conduct a front-end study of potential visitors' (in particular, teenagers' 11 to 19 years) interest, perceived knowledge and perceptions of the importance of various science topics that would inform the exhibition development process of the new science centre. Specifically, the study aimed to determine: 1) what types of science topics students would find of greatest interest; 2) the levels of perceived knowledge of proposed science topics; and 3) students' ideas for science topics they feel are important for Punjabis to

know about and would find personally relevant. As with most front-end studies, this kind of information is valuable in informing the design of the exhibitions and science programs that *Science City* will pursue. It serves to alert curriculum developers about topics that have a strong potential to draw audiences, provides insights about levels the science curriculum should be pitched, and also informs developers about unforeseen pitfalls

and assumptions that might be made about the science curriculum prior to exhibition and program development.

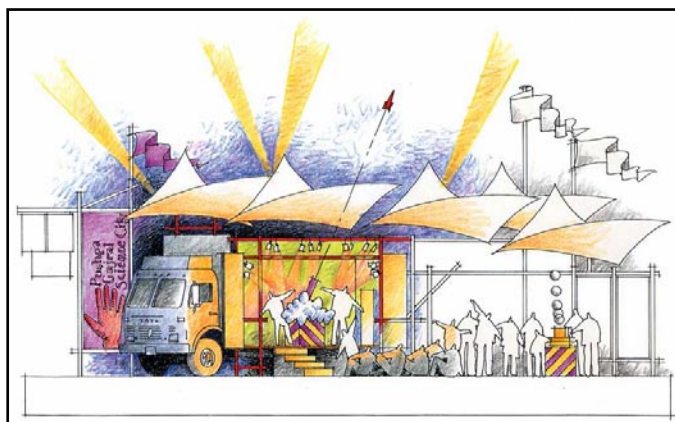


Figure 1. Artist's impression of a proposed gallery in the new Pushpa Gural Science City.

A specially designed paper and pencil questionnaire instrument was administered to 400 participants. The questionnaire comprised three types of questions: 1) Likert-scale type questions that allowed respondents to self-rate their interests and perceived knowledge of various science topics; 2) check box type questions that permitted respondents to express views about their interests in the proposed science centre activities and the perceived importance of various science topics to students of Punjab; and 3) open-ended, written response questions that permitted respondents to express their individual views and interests about science topics beyond those suggested in the questionnaire. *Science City* staff identified groups in the Punjab that share *Science City's* predicted demographics. *Science City* staff identified key people within these groups (for example, principals or teachers) who had their members complete the questionnaire. The completed surveys were returned to *Science City*, and then analyzed by staff at the University of British Columbia. Analysis was completed through a quantitative examination of Likert-scale and check box questions, in addition to a qualitative synthesis of the open-ended questions (Erickson, 1986). In addition, independent variables such as gender and age were cross-tabulated to identify any significant differences on the various dimensions – interest, perceived knowledge, and importance.

THE SAMPLE

The sample of 400 respondents was distributed roughly equally by gender (56% male, 44% female), and was dominantly in the age group 11 to 17 years. Thirty-eight percent (38%) identified themselves as being in the age bracket 11 to 14 years, while 56% identified themselves as being 15 to 17

years. By variable of self-reported level of education, the sample was comprised dominantly (75.6%) of those in Class/standard 6 to 10.

OUTCOMES

Teenagers' Self-assessed Interest in Various Science Topics

Participants self-assessed their interest in a list of 17 science topics proposed as potential science curriculum areas for exhibition and program development. Their assessments were made on a three-point scale (*I'm not interested, I'm a little interested, or I'm very interested*). Table 1 details the distribution of science topics by respondents' perceived interest. In addition, an overall rank ordering by relative interest was determined by assigning a score of 1 (not interested) through to 3 (very interested) for each assessment. The mean interest assessment for each item provides an indication of the relative level of interest in the suggested science topics. Of the 17 science topics presented, the top eight issues of most interest to Punjab teenagers included *the Internet and other computing technologies; exploration of outer space; robots; the evolution of life on Earth; the science of sport; astronomy; volcanoes, earthquakes & monsoon; and dinosaurs*.

Analysis by variable of gender revealed some statistically significant differences. Specifically, boys were 1.3 times more likely to be very interested in *robots* ($p < 0.001$), 2.3 times more likely to be very interested in *engineering principles* ($p < 0.001$), and 1.8 times more likely to be very interested in the *science of sport* ($p < 0.001$) than girls. Girls, on the other hand, were 1.4 times more likely to be very interested in the *chemistry of food and nutrition* than boys ($p < 0.021$).

Teenagers' Perceived Knowledge of Various Science Topics

Participants were asked to self-assess their knowledge of a list of various science topics on a three-point scale (*I don't know much about this, I know a little about this, or I know a lot about this*). Table 2 details the distribution of science topics by respondents' perceived level of knowledge. A similar strategy of rank ordering was applied to assess relative perceptions of knowledge. The top eight issues respondents claim to be most knowledgeable about were similar to the set they claimed to have most interest in. These included: *the Internet and other computing technologies; exploration of outer space; volcanoes, earthquakes & monsoon; the evolution of life on Earth; solar energy; dinosaurs; science of sport; and the chemistry of food and nutrition*. Conversely, more than one-third of respondents perceived themselves to be not knowledgeable about the topics of *robots; hydrology, environment, wetland, water pollution; Indian scientists, and the science of agriculture*. Moreover, more than half of all respondents perceived themselves to be not knowledgeable about the topics of *geology of the Punjab and engineering principles*.

Analysis by variable of gender and claims about high levels of perceived knowledge revealed some statistically significant differences. Specifically, boys were 1.8 times more likely to claim to be highly knowledgeable about *dinosaurs* ($p < 0.001$), 2.4 times more likely to claim to be highly knowledgeable about *robots* ($p < 0.001$), 2.3 times more likely to claim to be highly knowledgeable about *engineering principles* ($p < 0.001$), 3.2 times more likely to claim to be highly knowledgeable about *science of sport* than girls. On the other hand, girls

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Table 1. Perceived Interest in Science Topics

| Science Topic | I'm not interested | I'm a little interested | I'm very interested | Mean interest assessment (1-3 scale) |
|--|--------------------|-------------------------|---------------------|--------------------------------------|
| The Internet + Computer Tech | 6.5% | 20.6% | 72.8% | 2.66 |
| Exploration of outer space | 7.7% | 20.8* | 71.5% | 2.64 |
| Robots | 14.7% | 27.6% | 57.7% | 2.43 |
| The Evolution of life on Earth | 14.5% | 33.5% | 51.9% | 2.37 |
| The science of sport | 18.2% | 31.7% | 50.1% | 2.32 |
| Astronomy | 21.6% | 26.7% | 51.7% | 2.30 |
| Volcanoes, Earthquakes & Monsoon | 17.8% | 36.4% | 45.7% | 2.28 |
| Dinosaurs | 24.4% | 25.4% | 50.3% | 2.26 |
| Communication satellites | 17.9% | 37.1% | 45.0% | 2.26 |
| Indian scientists | 20.5% | 35.4% | 44.1% | 2.24 |
| Health issues in India | 16.0% | 46.3% | 37.5% | 2.21 |
| Solar energy | 21.2% | 41.2% | 37.6% | 2.16 |
| Hydrology + environment + wetland + water pollution. | 23.8% | 43.3% | 32.9% | 2.09 |
| Chemistry of food & nutrition | 24.5% | 44.2% | 31.3% | 2.07 |
| Engineering principles | 29.7% | 35.5% | 34.7% | 2.05 |
| The science of agriculture | 36.1% | 41.2% | 22.7% | 1.87 |
| Geology of the Punjab | 37.2% | 41.6% | 21.2% | 1.84 |

were 1.4 times more likely to claim to be highly knowledgeable about the *chemistry of food and nutrition* than boys ($p < 0.021$).

Teenagers' Assessment of Science Topics Considered Important

Participants listed the science topics they felt were important for them to know about. Table 3 illustrates that the most frequently identified issues included: *geology of the Punjab*, *health issues in India*, and *the science of agriculture*, which were identified as being important to know about by more

than 80% of respondents. Interestingly, these topics were also regarded by respondents as those in which they were generally least interested as illustrated by Table 1. Furthermore, Table 3 also illustrates that topics such as *the evolution of life on Earth*, *robots*, *astronomy*, and *dinosaurs* were regarded among the least important topics to know about, yet Table 1 illustrates participants' considerable interest in these topics. Thus, there appears an inverse relationship between topics that are considered "important to know about" and topics

that are perceived to be "interesting". Universally, the topic of *the Internet and other computing technologies* stands out as one that was regarded as being of both interest and importance to many respondents.

CONCLUSIONS

The findings emergent from this study are a fruitful first step in informing and charting the course of exhibition and program development at *Science City*, but also shed light on Punjabi teenagers' opposing perceptions of their interests and perceived importance of these proposed science curriculum topics. Moreover, the findings provide useful insights about teenagers' perceptions about science for science educators, science teachers, and anyone who holds an interest in communicating science to young people in the Punjab and India.

In considering these outcomes, the planners of *Science City*, and indeed, science teachers and educators, are confronted with several philosophical challenges. First, a challenge exists between addressing science topics that are of intrinsic interest to audiences versus topics that are deemed important within curriculum frameworks but may lack inherent interest for audiences. Science topics that hold an intrinsic interest for students are attractive foci to consider for curriculum development. Intrinsic motivation and the potential for a rich set of prior knowledge with which to make links, provide strong incentives for pursuing such topic areas. However, an identified lack of knowledge in part presents a compelling rationale for science educators to consider such topics as part of their curriculum. Ultimately, the choice of curriculum is dictated by an institution's or school's philosophy of science and science

Table 2. Perceived Knowledge of Science Topics

| Science Topic | I don't know much about this | I know a little about this | I know a lot about this | Mean self-assessed knowledge |
|---|------------------------------|----------------------------|-------------------------|------------------------------|
| The Internet + Computer Tech | 10.7% | 42.0% | 47.3% | 2.37 |
| Volcanoes, Earthquakes & Monsoon | 12.3% | 49.5% | 38.2% | 2.26 |
| The Evolution of life on Earth | 17.4% | 51.3% | 31.3% | 2.14 |
| Exploration of outer space | 18.6% | 51.4% | 30.0% | 2.11 |
| Solar energy | 17.3% | 58.5% | 24.2% | 2.07 |
| The science of sport | 31.3% | 40.3% | 28.4% | 1.97 |
| Dinosaurs | 26.5% | 50.5% | 22.9% | 1.96 |
| Chemistry of food & nutrition | 28.9% | 51.4% | 19.7% | 1.91 |
| Health issues in India | 24.6% | 62.2% | 13.2% | 1.89 |
| Astronomy | 32.4% | 47.4% | 19.9% | 1.88 |
| Communication satellites | 29.6% | 53.0% | 17.4% | 1.88 |
| Robots | 35.1% | 48.6% | 16.4% | 1.86 |
| Hydrology + environment + wetland + water pollution | 35.5% | 46.7% | 17.8% | 1.82 |
| Indian scientists | 32.4% | 51.1% | 16.5% | 1.81 |
| The science of agriculture | 36.2% | 47.3% | 16.5% | 1.80 |
| Geology of the Punjab | 54.4% | 35.0% | 10.5% | 1.56 |
| Engineering Principles | 54.4% | 37.0% | 8.6% | 1.54 |

education, and their needs and desires to align their curricula with regional spheres of influence. Within this there exists a philosophical tension between student-centered needs (what is of personal value to students in their socio-cultural worlds) and societal needs (what is deemed important within the context of the societal-world-view in which students live) as the focus that shapes curriculum. Given the cultural and regional context of the Punjab, curriculum and exhibit/program developers are challenged to balance topics that are seen by students as mundane but important

(e.g., the science of agriculture), with more globally attractive concerns, which students perceive as exciting (e.g., the Internet and other computing technologies). Of course, the key is to motivate students to feel passionate about both. Perhaps the lesson here is more basic than we make it out to be, in that curriculum developers should ideally hybridize the needs of both student-centered and societal-need domains (Carr, 1988; Posner, 2004; Schubert, 1986).

Second, there is something of a paradox evident among respondents'

views about what they consider important for Punjabis to know about versus topics they consider being of interest. Issues such as the *geology of the Punjab*, *health issues in India*, and *the science of agriculture* were considered important to know about, yet are considered to be among the least interesting science topics provided as options on the questionnaire. The challenge for science educators lies in identifying ways to make these science topics (viewed as important to know about) into ones that are also considered interesting and engaging. Designing and developing curriculum from the starting point of the audience's perceptions of the perceived importance and relevance of each topic is the first step toward building positive interest in such science topics.

Finally, there are some strikingly clear differences in both interest and perceived knowledge of some key science topics by the variable of gender. These outcomes confirm a number of other studies that have focused on gender differences and interest towards science (c.f. Barman, 1997; Honey, Moeller, Brunner, Bennett, Clements, & Hawkins, 1991; Jones, Howe, & Rua, 2000; Keller, 1985). The differences speak to the need for science educators at every level to be mindful of gender differences when it comes to the exploration and study of science. As educators we need to be especially mindful of our gender inclusive language and the images and metaphors we employ, to ensure no group is disenfranchised from the experience.

The research approach adopted here has provided useful insights for *Science City*, and science educators in general. The benefits derived from better understanding audiences prior to curriculum development ultimately increases the probability that the experiences provided are more widely

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Table 3. Perceived importance of science topics

| Science Topic | % of respondents who felt it was important for students of Punjab to know about this topic |
|--|--|
| Geology of the Punjab | 84.8% |
| Health issues in India | 82.7% |
| The science of agriculture | 82.5% |
| The Internet + Computer Tech | 79.1% |
| Hydrology/ environment/ wetland/ Water pollution | 73.7% |
| Chemistry of food & nutrition | 73.7% |
| Solar energy | 65.2% |
| Engineering principles | 61.3% |
| The science of sport | 59.8% |
| Communication satellites | 53.1% |
| Exploration of outer space | 50.0% |
| Volcanoes, Earthquakes & Monsoons | 47.7% |
| The Evolution of life on Earth | 46.4% |
| Robots | 43.8% |
| Indian scientists | 43.6% |
| Astronomy | 42.3% |
| Dinosaurs | 26.8% |

accepted and able to provide greater educational impact for those audiences. Moreover, such approaches assist in the more global mission of science educators - to improve attitudes and understanding of science and help create a more scientifically literate society.

However, the outcomes of front-end studies designed to clarify directions and decisions are not always clear cut, as was the case of the outcomes described in this study. Ultimately museums still must struggle with their own philosophies about the curriculum they display and interpret in the light of the outcomes of front-end studies they commission.

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FOOTNOTES

1. AdrichPears Associates is an exhibition design and planning firm based in Vancouver, Canada, comprising researchers, writers, interpretive planners, exhibit/graphic/ multimedia designers, project managers, and facilitators.
2. IPCS International, a Canadian Project Management and Project Development firm with projects in India and Canada.

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