# What robotics can bring to the teaching table

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Robots have always been a subject of fascination for young minds. Be it in a TV series (Vicki, the robot in Small Wonder), cartoons and comics (Irona in Richie Rich) or movies (Terminator Series), robots are an attraction for children. In this article, we reflect upon the experiences we had with students (over a broad age-range) during informal interactions such as science popularization events. We hoped to get some insight into students' ideas about robots, their interest in the subject, and the possibility of using robotics as a starting point to introduce them to design and technology. Robotics happens to be a field with the potential to combine different disciplines, such as electronics, biology, and design. Given its popular status, it can be a helpful tool in classrooms as it provides a fun context for children to start exploring and playing around with technology.

The word ROBOT comes from the Czech word "robota" meaning forced labour. Colloquially people understand a robot as 'one that mimics a human being'(Koren, 1985).

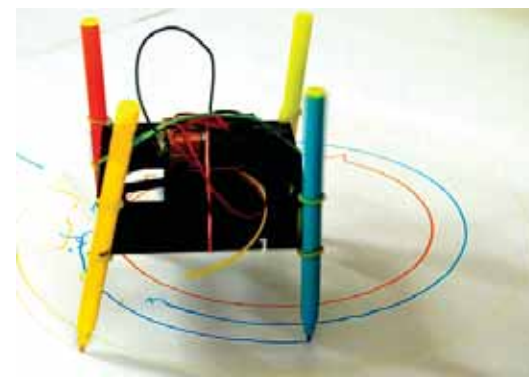
**Why bring robotics into education?**

Over the last couple of decades, a growing body of research in the area of early childhood education has emphasized the value of using constructivist methodologies in learning. Some researchers advocate the subject of robotics as part of early education since it can support the integration of constructivist practice and philosophy by engaging children and teachers in the active design of meaningful projects (Bers et al., 2002, p.124). Researchers have also suggested that robotics could be used to address the tenets of constructionism – learning by designing, manipulating (computational) objects to think with, exploring of powerful ideas, and being reflexive.

**Informal interactions**

The observations discussed below are mainly from four independent science popularization events with special focus on one that took place in a college in Wadala, Mumbai. In this college, we conducted a basic robotics workshop aimed at creating interest in and increasing awareness about robotics. We were also interested in eliciting students' ideas about robots. A total of 159 secondary and higher secondary science students participated in this workshop (74 girls, 80 boys, 5 did not indicate gender). We had sessions that involved completing a short questionnaire focused on students' ideas about robots and their uses and demonstrations of a squiggle bot (http://www.instructables.com/id/Easy-Squiggle-Bot/) with instructions on how to make one, and a session addressing student queries regarding career options in Science, Technology, Engineering and Mathematics (STEM) disciplines specifically in the area of robotics. The students chose the order of sessions randomly, based on availability of the resource persons for the sessions.

A squiggle bot is a rudimentary beginner's robot that can be used to scribble using markers or sketch pens.



Photos courtesy: Disha Gupta

While this workshop did not have many opportunities for students to work with their hands owing to time, space, and resource constraints, it did provide some insights into students' ideas about robots and how robotics could serve as a potential starting point for design and technology education.

**Students' ideas about robots**

A preliminary analysis of the responses to the questionnaire revealed that a majority of students considered robots as automated devices, which may be programmable and can at times be in the form of a human figure. In the questionnaire, students were asked to classify objects as robots or non-robots. In order to facilitate understanding of the objects listed, the words were accompanied by pictures of the object as well. A significant number of students in this workshop considered mobile phones, aibo toys and laptops as robots but bicycles and radios to be non-robots. When asked what criteria they used or how they decided to categorize the objects as robot or non-robot, some of the responses were as follows:

*Robots makes human work easy" (boy)*

*"The objects which are robots work on batteries or cell, but non-robots work when man-power is applied to it" (girl)*

*"From behaviour, working style, work done" (boy)*

*"Non-robot is when we have to apply work or force to make it work" (girl)*

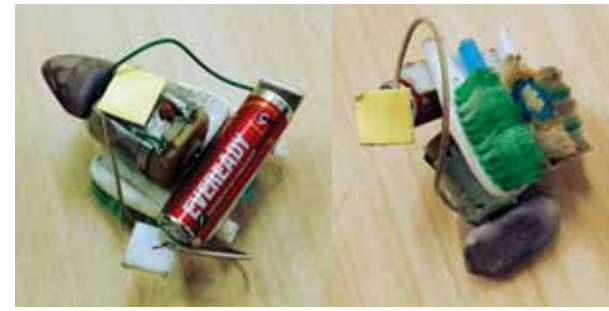
When asked which fields would robots be necessary in, students listed a variety of contexts.


Thus students identified a variety of areas where robots could be useful, both in STEM and non-STEM domains. In fact, many of their responses related to everyday life. Students were also asked if robots respond to changes in the environment. A majority of the students stated that robots do not react to changes in environment since *'robots are not like human beings or animals who respond to environmental changes'*.

In the workshop, students were also given a demonstration of how to make a squiggle bot using waste/inexpensive materials. This bot only required sketch pens, a discarded CPU fan (motor), and rubber bands. The CPU fan is powered by a 9V battery connected to a fan with insulated wires. A single battery can be used by the entire class to test their squiggle bots.

In the other workshops and science popularization events in this series, when the squiggle bot was demonstrated, we gave students an additional thinking exercise; they were asked to think of alternative components that could replace the sketch pens. Such an exercise allowed students' creativity to be expressed and they came up with an array of alternatives, such as 1) brushes, which would make it a cleaning equipment; 2) cloth, which would make it a mopping equipment; 3) knives, which would make it a chopper 4) whisker or beater, which would make it a batter whisker used in baking.

Incidentally, we recently had three student visitors (grade eight) who made a model which worked on principles similar to the squiggle bot. They made a cleaning device which had three used tooth brushes (bristle end) attached to a motor. The figures below depict the two sides of the model.




**Reflections**

Such incidents coupled with our interactions with children during the National Science Day suggest that children are eager to engage with designing and making. In robotics, we see a potential to carry out making activities in small setups or classroom settings, where students actually get some hands-on time with making and manipulating bots. Depending on the age group, one can explore possibilities of increasing the complexity of the task; for example, the bot can include a micro-processor

so that students have a greater control over the bot. Basic programming can be incorporated in the task so students can dabble with different movements of the bot (like clockwise or anticlockwise, differing diameter of the circles, rotations around a single point, etc.) and thus manipulate the design as per their interests.

Our interactions with children led us to believe that many of them find the subject of robotics intriguing. They also seem to have creative ideas about robots and their uses, which may be a result of media or other sources that they are exposed to.

The subject has potential to be used to introduce topics that overlap in science, design, and technology. But exposing students to such a complex topic for the first time can be challenging. Researchers have suggested more methodological approaches to introducing age appropriate robotics tasks to children, for example introducing simple programming to help children manipulate objects (Bers et al., 2002). Nevertheless, the fact that students are inquisitive and excited about learning such a topic can be tapped through easy activities around designing and making a simple robot in the class.

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