

Technological prayers: parents and children exploring robotics and values

Marina Umaschi Bers & Claudia Urrea

MIT Media laboratory

20 Ames St. E15-320

Cambridge, MA 02139

{marinau,calla}@media.mit.edu

“From the moment we enter school or church, education chops us into pieces: it teaches us to divorce soul from body and mind from heart.”

Eduardo Galeano “Celebration of the marriage of heart and mind.”

When children are young they ask all sorts of questions: “why is the sky blue?” “where does God live?” “how do cars work?” “why do people fight?” The curiosity of the child does not make a distinction between disciplines. Children are little humanists, little engineers, little theologians, and little scientists at the same time. As time goes by, school compartmentalizes children's curiosity into the curriculum. This is particularly striking in the case of technology and values, two areas that are hardly integrated in traditional education.

On the one hand, learning and teaching about values happens in public schools through character formation or moral education (Kohlberg, 1982), or in parochial schools, in religion classes. When values are integrated with other disciplines, it is usually with social

sciences or philosophy (Lipman, 1988). On the other hand, learning about technology (Ritchie, 1995) is easily integrated with math and sciences. Values and technology rarely meet in traditional schools. However, they are both present in the lives and concerns of children.

In this chapter we present an attempt to integrate learning about technology and values in a hands-on way, by involving families, as well as teachers, in the design and programming of robotic creations that represent their most cherished values. This attempt is the core of an on-going research program at the MIT Media Laboratory, which we call Con-science. This term is the English version of the Spanish "conciencia", formed by two words: the prefix "con", meaning "with" and "ciencia", science. Conciencia, as a whole, means consciousness or ethical awareness. We chose the name Con-science to highlight our educational vision of integrating values with the scientific and technological areas.

The premise of Con-science is that a holistic learning experience should respect and leverage children's curiosity as well as include the possibility to pursue both the technical and the moral questions in an integrated way. We believe that parents involvement in this type of exploration about values is essential because values are a very important issues to be left only in the hands of schools. The workshops held within the Con-science program have four pillars: 1) a design based constructionist approach to learning, 2) the use of new technologies, such as the LEGO Mindstorms robotic kit, to transform the designs into behaving mechanical artifacts, 3) the creation of narratives to complement the physical artifacts, and 4) the engagement of both parents and children learning together while building and programming artifacts that reflect their sense of identity and the values they live by.

This chapter tells the story of a first pilot workshop conducted in the Arlene Fern Jewish community school in Buenos Aires, Argentina, during the Jewish High Holidays, a period of ten days between the New Year and the Day of Atonement. We describe why we chose that particular site and dates, the workshop methodology, the participants, the technology used, the learning processes, the final projects shared with the community as creative prayers, and the future directions for the Con-science research program.

The pilot experience

The first pilot workshop of the Con-science research program took place in the Arlene Fern Jewish Community School in Buenos Aires, Argentina, during September 1998. The workshop had twenty-five participants: nine families (in pairs of one parent and his or her fourth or fifth grader), one child with developmental problems who came along with his special education teacher, and five adults (two teachers and three mothers who came alone because their kids were still too young to participate). Children were granted special permission from the school principal to miss a week of classes and participate full-time in the workshop. Parents made a big effort to attend the workshop by taking time off from work.

The timing of the workshop was carefully selected to overlap with the Jewish High Holidays, a period of ten days in which the community gathers to celebrate the Jewish New Year and the Day of Atonement. In this context, children's curriculum focuses especially on the values of these festivities, the most holy in the Jewish calendar. To hold a workshop during these holidays was very meaningful because of the spiritual work of reflection and forgiveness that takes place both in the school and the community. The workshop was a first step towards forming a group of parents, children and teachers who would later integrate this approach to values and technology into the school's curriculum and make it available to a wider audience. The MIT team would only be external consultants. For instance, since the first Con-science workshop ran, two other workshops in the same spirit were organised in the school by former participants parents and children in the first experience.

The site

The Arlene Fern Community School has certain characteristics that made it a unique pilot site for starting our research program. Perhaps the most salient is that it is a value-centered learning environment which emphasizes the importance of "being" in addition to "knowing." The school's mission is to educate not only the children, but also the family and the community. The school is based on a liberal Jewish worldview; however, its approach

to universal values and its search for meaning and spiritual growth, while rejecting dogmas and certainties, applies to broader religious and cultural traditions.

The school was funded in 1997 by Rabbi Sergio Bergman as part of the Emanu-El community, the only Reform synagogue in Argentina. Today it has 150 students and 10 teachers. It includes kindergarten and elementary school with a trilingual program in Spanish, English and Hebrew. It is a private school but, in accordance to its ideological social action position, it gives full scholarships and half scholarships to those in need. Children with special needs and developmental problems are welcomed and integrated into the classroom, with the constant tutoring of special education teachers.

During the Jewish High Holidays the school organizes activities for the whole family. For example, they engage in creative prayers by writing, dramatizing or drawing their own prayers about meaningful contemporary themes. Usually there is an open house in which the creative prayers are shared with the community. This provided an excellent opportunity to present the process and products of the Con-science workshop to the community.

One of the key elements to decide the pilot site was the fact that there were already established contacts with the school and its founder and spiritual leader, Rabbi Sergio Bergman. Bers, who is from Buenos Aires, has worked closely with Rabbi Bergman for many years. Rabbi Bergman has also participated in several other activities related to values, education and technology organised by MIT (Bers & Bergman, 1998), as well as in the 2B1 gathering that took place at the MIT Media Lab in the Summer of 1997. This conference was aimed at creating a network of people doing interesting educational projects in developing countries. As a follow up to this gathering, a group of parents of the school created a self directed after-school Logo group which has been actively engaging families in the design of computer games to teach about Jewish values and festivities. This group formed the nucleus of parents who participated in the experience described in this chapter.

The motivation

Motivating the Con-science research project is the underlying philosophy of constructionism (Papert, 1980). It asserts that learners are likely to construct new ideas

when they are building artifacts that they can reflect upon and share with others in their learning community. Constructionism is not only a theory of learning but also a theory of education. Therefore it takes an interventionist perspective and concerns itself with the design of learning environments (Harel, 1991; Hooper, 1993; Cavallo, 1999) and construction toolkits to support children to make epistemological and personal connections (Resnick et al, 1996).

Some of these construction toolkits, like SAGE (Bers & Cassell, 1998), are purposefully designed to support children's exploration of their identity and values. SAGE has a programming language to build a wise character that engages in a conversation and tells inspirational stories to help children make sense out of their personal dilemmas, as well as an animatronics interface, a stuffed rabbit with a small computer inside, which children can program to determine the body movements of the character.

Other construction toolkits do not have a specific goal in mind and can be used for different purposes, like the programmable brick (Martin, 1999), and its successor, the crickets, described at length in chapter X. This technology is a tiny, portable computer embedded inside a LEGO brick. People can build all sorts of artifacts as well as program them to interact with the world through sensors and motors. Traditionally the research experiences that would use this technology involved the integration of robotics, engineering and programming with disciplines such as math and sciences. For example, the Beyond Black Boxes project (Resnick et al, 1997) develops computational tools and projects that allow children to create their own scientific instruments and become engaged in scientific inquiry not only through observing and measuring but also through designing and building.

In the same design spirit, the Con-science research program seeks to develop tools and methodologies to help both children and parents learn together about technology and explore their values. In this section we present the research methodology, including evaluation techniques, and the technology used in this first pilot workshop in the Arlene Fern Community School.

The methodology and evaluation

We worked with a project-based immersing methodology. By project-based learning we mean that learners were asked to choose a project that they would like to work on for the whole duration of the workshop. They were involved in all aspects of the project. They chose the values to explore, decided the materials to use, managed the resources and time-frame, resolved the technological challenges (both in terms of programming and mechanics), created a narrative around the final project, and presented it to the other members of the community through creative prayers.

By immersing learning we refer to the notion that learners immersed themselves in the learning process by having a lot of time devoted to play and to explore their ideas in depth. For example, in this particular workshop, we worked with parents and children during five days, eight hours a day. During that time, participants could try many ideas and had enough time to iterate through different versions of a same idea. Each participant was asked to keep a design notebook to document the project progress as well as ideas and difficulties. We created a workshop web-site to collectively document the experience. A machine was dedicated to function as a local web-server. People were encouraged to add their own thoughts and descriptions in Spanish. Each night, we would translate into English, then edit and organize the different web pages. Since this was the first pilot workshop within the Con-science research program, documentation was very important to allow future experiences and comparative studies.

Innovative learning experiences can not be evaluated with traditional techniques. To evaluate this workshop we utilized a qualitative approach that included interviews with participants, observations of interpersonal relations and their use of the new technology, changes in their ways of approaching a problem and thinking about conflicting issues, analysis of the personal design notebooks and final projects, comments wrote in the web-site, posters and wish-cards created for the open houses, and ways of presenting their creative prayers to the community. The workshop was video-taped both to document the experience and to facilitate us to go back to certain key moments and analyzed what happened

During the workshop, we observed people deeply engaged in discussion about values, and we also observed some change of attitudes related to what is right or wrong. For example, at the beginning of the experience, most of the participants, both children and adults, rushed to collect as many motors and sensors as possible, without taking in consideration their real needs. By the end of the workshop we observed that people started to share limited technological resources without a top-down intervention.

The technology: hardware and software

The technology we used during the workshop is called LEGO Mindstorms Robotics Invention System. The set contains an average of 700 LEGO pieces, the Mindstorms RCX or tiny computer embedded in a LEGO brick, an infrared transmitter for sending programs to the Mindstorms RCX, the Mindstorms software, light and touch sensors, motors and a building guide. The Mindstorms RCX has been under development for almost 12 years. It has been the result of the collaboration between LEGO and a group at the MIT Media Lab lead by Fred Martin. The Mindstorms RCX is an autonomous microcomputer that can be programmed using a PC. It uses sensors to take data from the environment, process information and power motors and light sources to turn on and off.

During the first day of the workshop we experienced what became a constant problem: The infrared communication between the Mindstorms RCX and the computer was affected by the intensity of light in the room and by interference with other bricks nearby. The operational system of the RCX, Firmware, which needs to be downloaded before usage, was getting corrupted. While some kids complained: "Someone is putting programs in my brick", as if it was a conspiracy, others started to invent their own ways to get around the problem. They hid the bricks from each other, put them under the table or covered them with a piece of paper in order to avoid interference.

The RCX software is an icon-based programming language, loosely based on LOGO. It allows users to drag and drop graphical blocks of code that represent commands such as left and right turns, reverse direction, motor speed, motor power, and so on. Users can drag the icons together into a stack, in a similar way than assembling physical LEGO bricks, and arrange them in logical order to produce new behaviors for a robotic construction. This

graphical environment became an easy to use tool that facilitated the programming task for the novice children and parents. Yet, some parents who were experienced programmers found the environment frustrating and limiting. For example, it is difficult to implement "OR" and "AND" conditions using the Mindstorms software and a complex solution needs to be conceived.

The process: the Con-science workshop day by day

As we mentioned earlier, we created a web-based journal documenting the pilot experience. In order to convey the spirit of the workshop, this section is composed of short excerpts from it. The full text and pictures can be accessed at <http://el.www.media.mit.edu/projects/con-science/>

First Day: Becoming familiar with the technology

Participants gathered to start the activities. Each one introduced him or her-self. We explained the workshop's goals talked about previous experiences with the technology and showed some videos. The first activity of the day was designed to help people become familiar with the Mindstorms RCX, the sensors and motors and the programming language. They were asked to start a motor or initiate a routine when a touch sensor was pressed. The groups spontaneously started to build little projects and learning the programming aspect. Most of the groups built vehicles that could move and respond to a sensor's stimulus. Only one of the groups used the gears to build a pulley for an elevator, and not a car or truck.

In the afternoon the task was to build kinetic sculptures using not only LEGO pieces, but also art materials. The goal of the activity was to push their thinking in different directions, other than building cars and trucks. It took some time, but people came up with merry-go-rounds, flowers that open up to the light, dancing dolls, cargo transporters and sweeping robots.

By the end of the day, the groups presented their projects. Some of the children appreciated the fact that there were other materials than LEGO, but others complained about the

difficulties of plugging motors and sensors in the right places. Marcia¹, a nine year old girl, was very happy because she was able to spend a long time with her father without him getting upset at her. With a big smile she said, "Parents are great when they do not get upset" and intentionally, and for the first time in the workshop, geared the conversation from technological issues to social ones.

Second Day: Starting the final projects

In the morning every group presented the details of their project's programming. The goal was to create common ground for the groups by sharing problems and programming tips with each other. Since some of the youngest kids were very confused we decided to organize a theatrical improvisation to help them understand the different programming blocks and the control flow. Some kids pretended to be commands that turn motors on and off, others played as sensor watchers that trigger an action and others as control structures such as "repeat forever."

After this exercise, we introduced the topic of integrating values and technology. As a first step we showed them a project we had built that integrated them. This project called "The scale," is an example of transforming an abstract value, such as the "balance between the good and bad actions of the previous year," into a concrete artifact that responds to people's interactions. The scale had two buckets on each side, one for good actions and another for bad actions (see figure 1). Volunteers were asked to write on a piece of paper an action from that year. They hid the paper in a little wooden cube and put it in the corresponding side of the scale. Light sensors were used to detect when new actions were placed in any of the two buckets. A program detected the event and kept count of the number of actions in each side. After a participant finished putting his or her actions in the corresponding buckets, a touch sensor had to be pressed. This started a sound that qualified the balance of the year, either positive or negative. Finally, a motor-driven contraption opened a small box that offered a poetic message for reflection.

¹ In order to protect subject's anonymity, all names of the workshop participants have been changed.

This example was a concrete introduction to our goal of integrating technology and values. Rabbi Bergman led an activity to explore the values of the Jewish High Holidays. During a long discussion, people suggested a list of relevant values such as forgiveness, friendship, celebration, memory, balance and judgment. We made cards with each of the proposed values. When the groups started to select the materials to use for their final projects (e.g., sensors, motors, card-board) they also chose one or more of the cards with the values that they wanted to explore.

During the afternoon, the groups worked on the design of their final projects (see figure 2). They discussed different ideas and used their design notebooks to do quick prototypes. At the end of the day each group gave a progress report and described the project they wanted to build by the end of the week. Most of the parents found it very easy to integrate the chosen values into their technical design. Some of the kids complained that the activity was not as fun as some earlier ones because they had to think hard before adding new pieces to their contraptions. "Yesterday every piece I found I could fit into my project. Now it is more serious, and I can't put any piece anywhere. I have to think about the overall meaning of the project," said Marco, a ten year old boy who was very excited by the engineering aspects of the activity.

Third Day: Working hard

The groups exchanged ideas and suggestions about their projects. Juan and Enrique, fathers who are engineers, helped other groups to improve their projects by building stronger structures. The more advanced groups started to prepare for the next day open house for the school children, teachers and staff. For example, Miguel, an architect and father of a nine year old boy, drew a complex model of the star of David that his son was building with LEGO. Ema, a special education teacher, made a big poster with the control flow of her group's project. Rabbi Bergman brought the shofar, a sheep horn blown during the High Holidays, so kids could compare its sound to the melody they were programming in the computer.

A group of people working on a conveyor belt that transported actions had a hard time finishing their project. At first we thought that the problem was caused by some logical bug

on their part but later, we discovered that it was due to the difficulty of implementing “OR” and “AND” conditions using the Mindstorms software. Finally, with some help from our part, they implemented a complex solution (see figure 3).

Fourth Day: The school open house

The school open house had two goals. First, to show to the rest of the school what the Conscience workshop was about. Second, to be a rehearsal for the Friday’s creative prayer, in which project’s demonstrations were going to be given for the wider community.

During the school open house most of the parents decided to pass to their kids the task of showing their projects to their peers. Juan, the father of a nine year old, was surprised to observe his daughter explain in full detail the programming aspects of their project. The open house lasted two hours during which the young visitors asked lots of questions.

The workshop participants were very proud to show their projects to their classmates and assumed a pedagogic role while explaining how sensors, motors and Mindstorms bricks worked. Children who seemed very dependent on their parents during the workshop, were completely on their own during the open house and parents that were very involved during the workshop relaxed during the open house, and let their children take the lead.

Fifth Day: Evaluating and preparing for the creative prayer

During the last day of the workshop we had two tasks in front of us: to evaluate the experience with parents and children and to prepare for the creative prayer open house on Friday. The creative prayer was going to happen in the synagogue before the religious service. The solemnity of the space and the sacredness of the day, the most important Sabbath of the year, made it a very big event.

As a way to evaluate the experience we decided to write a collective prayer to thank for all the new things we learned and experimented with during the workshop. One by one every participant went to the blackboard and wrote his or her contribution. Later we transcribed it into a big poster to hang in the temple and we made photocopies to hand out to the visitors

with their prayer books. The collective prayer read as follows: "We, the participants of the Lego-Logo workshop give thanks because: we had the possibility to experiment, to work and to share new materials with classmates, our parents and people who we didn't know before. We were creative and we could build projects that express what we believe, feel and live by. We played with materials that opened up many new possibilities. We shared in community and we were able to create while playing."

Besides the collective prayer, every group prepared a blessing or good wish card to emphasize the value worked on their projects. The idea was to hand them out to the visitor, as if they were business cards. For example, the group who chose the value "give and receive" wrote: "We wish that in this New Year you have many opportunities to give good moments and receive lots of love." Many groups accompanied the text with drawings made in the computer.

Sixth Day: The creative prayer open house

The open house for the community was held in the synagogue as a creative prayer. We installed the computers, the projects and the posters in one of the corners in the synagogue. An hour before the religious service, we invited the community members to walk around, ask questions, play with the projects and talk with the presenters (see figure 4). The blessings or good wish cards were very successful and were distributed non-stop. The group of parents that started to work with Logo MicroWorlds a year before also showed their projects. Even though the number of visitors kept growing, the open house ended with Rabbi Bergman inviting everyone to sit down to continue with the traditional religious service. During the sermon, he referred to the learning experience that took place during the workshop and connected the act of creation in which everyone was involved with our role of partners in the creation of the world.

The projects

In this section we describe some of the projects built by parents and children. We group the projects into three different categories according to the way in which the technology was used to explore values: 1) technology to **represent symbols**; 2) technology to **represent**

values; 3) technology to **evoke reflection and conversation**. Projects in the first category, technology to represent symbols, treated values in a shallow way. People created artifacts that resembled the Jewish symbols without deeper exploration of the nature of the values represented by these symbols. Projects in the second category, technology to represent values, involved both artifacts and stories that made the chosen value more explicit. Projects in the third category, technology to evoke reflection and conversation, treated values in a more elaborated way and provided an opportunity for others to engage in experiencing the complexity of the chosen values and participate in thoughtful discussion.

This taxonomy of different ways of using the technology to explore values was not in our mind before the workshop. It resulted as we analyzed and compared the different projects and learning experiences.

Technology to represent symbols

Every tradition has symbols that reinforce a sense of group identity. The Jewish tradition is particularly rich in these symbols which are usually associated with a festivity or a ritual. To recognize and distinguish the symbols of a tradition is one of the first steps towards building knowledge about the tradition and eventually identifying with it. Often times, symbols are used by educators as a way to give concrete shape to abstract values. However, a rich educational experience can't be limited to learning about symbols. Symbols should be a gateway to deeper explorations of the values and socio-cultural practices of a tradition.

During the workshops several groups used the technology to create symbols. For example, Michael, a ten year old boy said: "We built a 'Maguen David,' Star of David, as a symbol of our Jewish people and we programmed it to turn forever like the wheel of life and have flashing lights resembling candles welcoming the New Year. We also reproduced the sound of the shofar. It has three different tones that are supposed to awake us for reflection and atonement." Michael's group chose the value "awakening" or "call for reflection." They designed their project by anchoring it to traditional symbols. The construction of the star was done in a very careful way out of LEGO pieces and flashing lights. The center of the star was connected to a platform that moved with a motor. They used a touch sensor to

launch and stop their program, which had three basic jobs: turn the motor on, turn the lights on and off, and play the sound of the shofar (see figure 5).

A second project on this category was built by Paul and Ariel, father and nine year old son, who chose the apples and honey that symbolize the wish to start a sweet New Year. In every Jewish home, during the first dinner of the New Year, there is a plate with apples to dip in honey. When talking about his project Paul said, "We built a crane that transports apples from one place to the other in order to prepare them to celebrate Rosh Hashanah (New Year)." Paul and Ariel were very intrigued by the idea of building a complex car-like artifact (see figure 6). When showing their project to others they would explain the details of its mechanics and program and would very often forget to make the connection with the chosen value "sweetness." The crane car was built with the Mindstorms RCX as a remote control connected with touch sensors. They used three touch sensors. The first sensor moved the crane, so when the sensor was pressed, the program started the motor to make it move forward, and if pressed again, it changed the direction to make it move backward. The second and third sensors were used to control the palettes. When the crane reached the platform of apples, one of the sensors had to be pressed in order to open the palettes, then the other sensor in order to close the palettes and pick an apple to transport to the honey plate.

The examples presented above show how certain groups used the technology to create projects that represent Jewish symbols. Although they started to connect these symbols with their meanings, they did not explore in depth the relationship between the values and the symbols.

Technology to represent values

Some people created projects that used the technology to represent values not only as a symbol, but also as the theme. For example, a group chose the value "friendship" and created a puppet theater. The theater had a curtain that opened to show the performance of two LEGO dolls hugging after a fight (see figure 7). Marcia, nine years old, created a story about the girl's situation and the connection with some of the values of the high holidays, such as "Teshuva." "This project tells the story of two girls that after a fight give each other

a hug and become best friends,” explains Marcia, “This project talks about the ‘Teshuva’ that allows us to repair our mistakes. The friends did ‘Teshuva’ and became friends again with a big hug.” Marcia built the dolls with LEGO bricks, attached colorful strings as hair and placed motors in the arms to swing back and forth simulating a hug.

The “friendship” project used technology as well as storytelling. Since the chosen value was the main element of this project, the group seemed to have the need to tell a story to reinforce the interpretation of the value. They wrote the story in the good wish card that was handed out to visitors during the open houses. Telling a coherent story around the robotic creation was as important as getting the mechanics and the programming right. They used technology to represent a value as a powerful idea that needs to be supported by both a behaving artifact and a compelling story.

Technology to evoke reflection and conversation

Some groups used the technology to design an engaging activity for others to experience their own interpretation of the chosen value. For example, one group chose the value “giving and receiving.” Juan, one of the fathers in the group said: “We talked a lot about giving and we found out that giving is, at the same time, receiving. So through our project we wanted to show that when we give something we do not exactly know what we are receiving but we always receive something back.” Pattie, Juan’s eight years old daughter, explained this idea with a concrete example: “We made a doll with two yellow hands and every time you give her a present in her hand, she turns around and gives you something back with her other hand. But you don’t know what she is giving you. There are smiles, flowers and hugs in her second hand and you can receive anything.” (see figure 8). The first component of the “giving and receiving” project was the head of the doll, built out of materials they glued and colored in an artistic way. The body consisted of gears, which provided strong motion to the rest of the doll, and a motor attached to a rotation sensor to keep track of the turns. Both hands had light sensors and light sources. They used the source to make the light more constant, so the small changes in the light reading were easy to detect. They wrote a program that detected a new object in the receiving hand, made the doll turn to offer a gift with the giving hand, and waited to turn back after it detected the

taking of a gift. This was a very complex project both in terms of technology and mechanics as well as in the conceptualization of the value they chose. The group spent a long time conceiving a design that would actually represent the notion of giving and receiving. They found the doll and her two hands a very appealing one.

Another example of the creation of projects that evoked reflection and conversation is the case of Paula and her ten year old son, Matias. With the help of two other moms, they created a conveyor belt contraption that transports the actions of the previous year (see figure 9). Paula explained how they came up with the idea: "During the High Holidays we think about the actions in our everyday life. It is the time to think, reflect and become conscious about our past deeds, so we can choose to continue with the good deeds or to rectify the actions that we believed were wrong." This idea gave birth to the conveyor belt. The machine was designed to carry actions until a reflection point, where the users could spend the needed time to decide about their positive or negative significance. An action considered good was transferred to a good container, and an action considered bad was taken back, meaning that people had to amend it. The mechanics consisted of a structure to hold the belt, which was made out of rubber bands, a motor located in the starting point of the contraption to move the belt, and two touch sensors to select between good and bad actions. Actions were foam rubber cubes wrapped in color papers and labeled with a name. A program was created to start the motor for a given number of seconds, and wait for the sensor input to take the actions to the next stage. If the sensor for good actions was pressed, the program started the motor in the same direction to go forward. If the sensor for bad actions was pressed, the program made the motor move in the opposite direction taking back the action to the starting point.

For the two groups presented above it was very important to have users of their projects not only learn the value of reflection, but also experience it by reflecting about their own actions. During the open houses they were very careful to explain both the complex mechanical structure and the state of mind into which they wanted the users to be drawn.

Technology and Values

Learners have different interests and strengths. Some are naturally inclined towards the humanities, while others prefer technology. Within Con-science both technology and values are integrated to support diverse learners. On the one hand, we noted that those interested in values, but not in technology, ended up mastering the technology due to their high motivation to build an artifact that expressed their values. On the other hand, we noticed that people who initially only wanted to work with the technology also ended up exploring values by the need to choose a project theme.

Interest in values supports learning about technology

Let us go back to Marcia's project on friendship. She had a hard time building the mechanics for the movement of the arms, as well as writing the program to control the hug. Her dolls looked as if they were hitting each other instead of hugging. When showing the project to the young visitors, one of the youngest ones complained, "This is not about friendship! The dolls are not hugging but slapping each other." The young boy was referring to the fact that both arms wouldn't move up at the same speed and wouldn't reach the same altitude. Marcia tried to convince him that he was wrong and created a very complicated story about a new type of hug. But the young boy wouldn't give up and invited his friends to give their opinion. After engaging in a long discussion about what friendship is, everyone agreed that the project wasn't about friendship but about fighting. Marcia wasn't happy. Next day she talked with the other group members and they all agreed that there were two possible solutions. She must either change the story and the value conveyed by the project or work harder on the programming. Despite the fact that Marcia said that she hated programming, she chose to do it because friendship was a very important value for her. She debugged her program and played with the mechanics until she came up with a movement that looked very much like a hug.

Marcia's story is about how the technology was used to engage a child in a high intensity intellectual effort. Marcia's friendship theater, and the fact that it wasn't working as expected, generated an in-depth discussion about value issues such as what friendship

means. In a normal class situation this philosophical discussion would have been initiated by the teacher (e.g., the teacher telling a story about friendship and asking kids to comment on it), or at a very high personal cost (e.g. if there was a fight in the classroom and the conflict needed to be resolved). The personal attachment that Marcia had to the value she chose motivated her to work harder to debug her program. Given Marcia's preferences, it would have been easier for her to change the theme around her project, than to fix the programming. Yet she benefited from learning to find a solution with the technology.

Interest in technology supports learning about values

During the open house for the community, Matias presented the conveyor belt that transports actions. When playing with the contraption, one of the adult visitors pressed the "good action" touch sensor and observed the action block move forward very slowly. He commented: "I see, the good actions take more time. Since they are good, they should last longer." Although this deep reflection about values was triggered by the performance of the technology, this wasn't the original reason why Matias' contraption performed in that way. The belt structure was divided in two parts because the rubber bands were not long enough to cover the whole area. They were slightly different in length, which affected the speed in which the actions traveled on the belt. Before the visitor's comment, Matias seemed to only explained the difference in speed in technical terms, but after he became interested in this new way of explaining why good actions travel slower than bad actions.

This incident shows an example of ways in which the richness of the learning environment encourages people to explore news areas. The comment made by the visitor raised for Matias the issue of how actions happen in real life. During the workshop Matias showed more interest in the technology than in the values aspect of his project. The fact of building a tangible artifact to share with others, however, helped him to reflect about the experience in a different way. During the creative prayer in the last open house, Matias demonstrated his project by explaining how the value he had chosen with his group was conveyed and implemented in the project and how the technology worked.

Learning families

During the workshop, parents and children were faced with many challenges. Some were technological and others personal. Most the participants were not used to spending long hours working together with member of their families, as partners, on a project that involved new skills and new materials. The traditional role of the parent as "know-it-all" person and the child as the learner were disrupted. Although in some cases, parents still knew more than their children, as it was in the case of parents with engineering and computer training. In general children were more familiar and confident with the work. For example, most of the boys were very familiar with the LEGO bricks, and most of the children had an easier experience learning and doing the programming.

According to their own idiosyncrasies and family dynamics, they accepted the challenge with courage and found their own ways of interacting. For example, a father and his eleven year old daughter, Carolyn, spent a lot of time discussing the goals and implementation of the project as if they were two adults in a work meeting. Their relationship was as equals. Some times they would take turns in trying out different technical options while at other times they would debug together. In our opinion, this group did not manage to make a final project that reflected the complexity of the underlying thought processes and serious debates, but the real value was in the process through which they conceived and implemented their project.

Other families couldn't work as equals. Either the child or the parent took a dominant role at different times. For example, the ten year old Michael, while working on the computer programming the Star of David would ask his dad to bring him water and cookies because he was too busy to interrupt. In his opinion, his father wasn't able to help him with the programming. In a similar way, his dad, an architect, would build the complex star out of LEGO bricks and would ask Michael to find for him the needed pieces, without letting him intervene in the design. With the exception of two fathers who are engineers and a mom who is a computer scientist, it was common for kids, particularly boys, to take over the programmer's role. For example, Miguel proudly wrote in the web-site that his mom couldn't figure out how to program the Mindstorms brick but he managed to master it without much effort. The truth is that his mom tried to learn the programming environment but every time she would get close to the computer Miguel would take over.

Conclusions

Issues regarding values and education are controversial: Whose values are to be taught? How to avoid indoctrination without ending up with a relativistic perspective? These questions do not have an easy answer and some people have chosen to avoid them by rejecting moral education in public schools. In religious schools like the Arlene Fern, most of these issues are resolved by the fact that there is a shared agreement about the virtues cherished within the community between all the parties involved in the educational process. Schools of this sort are up front about their concern with the students' development of a lifestyle, a mindset and a behaviour system within a certain moral landscape.

Even though indoctrination is not an issue in this type of education, two questions still remain. First, how can the teaching and learning about values be made into a concrete hands-on activity? Instructionism, the educational approach which proposes that information needs to be transferred from the teacher to the learner is not always an effective model (Papert, 1993). Constructionism seems to be more appealing due to the personal investment of the learner, the emphasis on making artefacts to make ideas concrete, and the ability to test them in the world. By constructing an external object to reflect upon, people also construct internal knowledge. Constructionism, however, needs materials in order to construct. The richer the materials, the more potential the learning experience has for the participants.

Story telling and story writing have been the traditional materials for values education. When these activities are augmented by new technologies, such as the Internet, they offer new possibilities. For example, Kaleidostories is a web-based narrative environment that supports children's expression by offering them the tools to create role models and stories conveying values. Every child participating in the experience is represented by a figure in the kaleidoscope. Its colour and shape changes according to how many role models and values are shared between the logged user and the other participants. Children can send messages to each other and engage in discussion about similarities and differences (Bers, 1998). Although tools of this sort are explicitly designed to help children explore their values and seem to fit naturally with the goal of integrating values and technology, robotic

construction kits, as shown in this paper, can also be very powerful tools. They precipitate discussion about values as well as provide material to build concrete artefacts representing a chosen abstract value.

The second question regarding values in education has to do with how to involve the family in the learning process. Values are not something that we hold only when we are in school. Values are part of one's entire life and need to be understood in the context of who we are (e.g., our identity). Therefore, values education should engage the family. In the Con-science program we involve both children and parents. As shown before, they worked together on robotic projects that gave physicality and dynamism to abstract values cherished during the Jewish High Holidays. Parents and children shared a space to talk about values in a concrete way and to engage in a different type of relationship. Despite their difference in age and experiences, both parents and children were faced with the challenge to gain new insights about both technology and values.

During the workshop we observed that both parents and children were gaining technological and moral fluency. The term *technological fluency* refers to the ability to use and apply technology in a fluent way, effortlessly and smoothly, as one does with language (Papert & Resnick, 1995). In the case of the Con-science program, people were able to use the technology in a creative way to make projects that represent their most cherished values. According to their initial familiarity with programming and building, they became technologically fluent in different ways.

By *moral fluency* we imply the ability to be fluent regarding issues in which there is a right and wrong, responsibilities and consequences, and different points of views and alternatives to chose. This is the basis for developing a sense of responsibility for the actions that we take in the world, creating an awareness of the connection between who we are, our identity, and what we consider most worthy, our values. For example, during the workshop participants engaged in thoughtful discussion about the nature and contradictions of the act of giving and receiving and the different points of view about what friendship is.

Despite the success of the workshop in terms of motivating these discussions, we believe that moral fluency, as well technological fluency, takes time to achieve and requires hard

work. But once acquired, they have an impact in ways of thinking as well as behaving. The passage from the moral thought to the moral deed is a very hard task and we can not claim that the workshop participants accomplished it. If some of them showed signs, it is probably due to the value-centred environment they are engaged in throughout the year and not only during our workshop. The behaviours that participants exhibited, particularly the children, served as indicators for the school of the successes and failures of its mission.

We hope that this first pilot workshop within the Con-science research program can serve as a seed that will give birth to other projects with similar goals. Our plan is to work with different secular and religious groups concerned with bringing technology and values together and be able to do longitudinal and comparative studies between the types of projects and values chosen by different populations. Hopefully our research will contribute to envision an education that doesn't chop us into pieces, as the initial quote by Galeano pointed out, by divorcing soul from body, mind from heart, and technology from values.

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List of figures

Figure 1: The scale

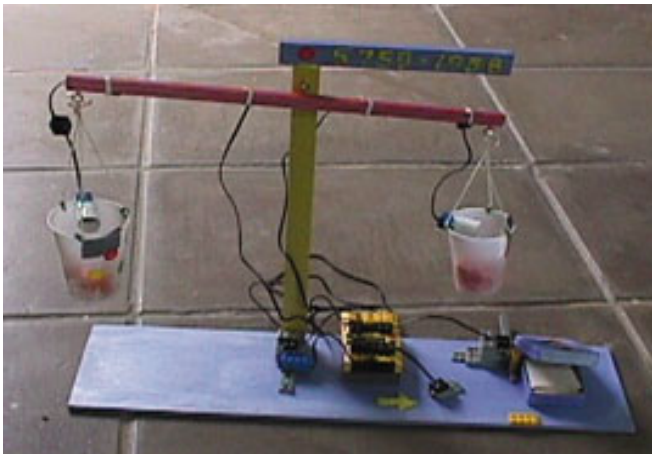


Figure 2: People talking in the workshop (workshop spirit)



Figure 3: snapshot of RCX code



Figure 5: start of David

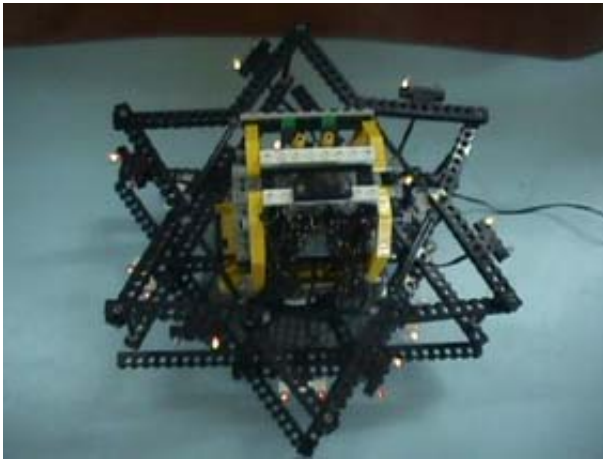


Figure 6: honey car

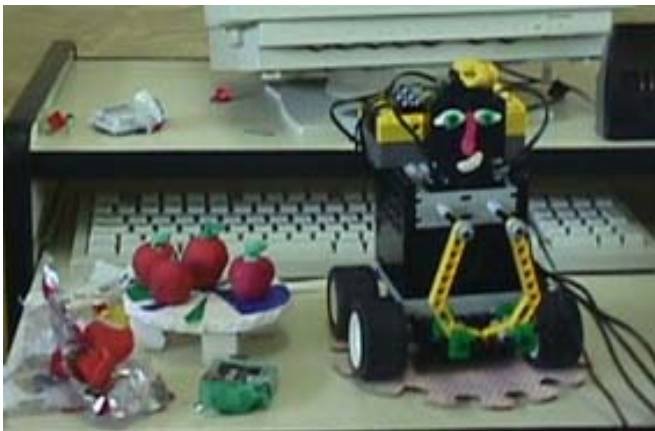


Figure 7: friendship

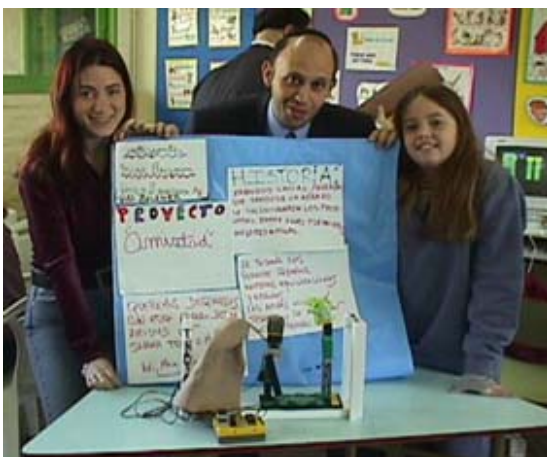


Figure 8: give & receive

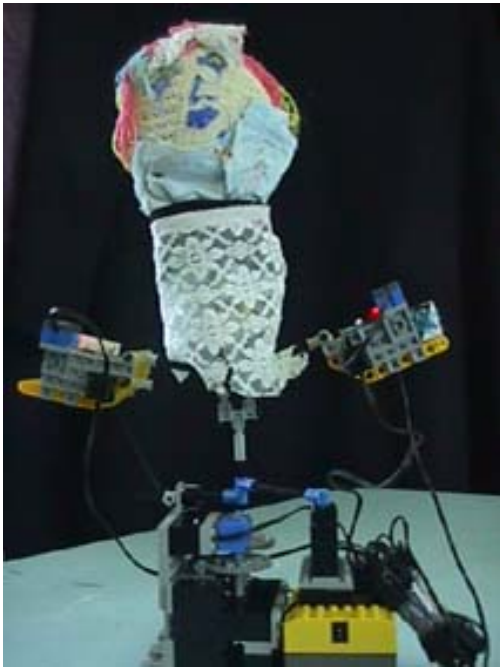


Figure 9: conveyor belt

