Abstract

In this paper, we examine a popular educational tool, LEGO Dacta’s ROBOLAB, as a technology of the self. The technology, which was developed with a specific educational philosophy, has proven effective in classrooms over the past fifteen years. We now look at its impact not only on academics but on the children’s self image. Suggestions are offered on how to adapt this powerful technology as a tool for us to reflect on the self, and to gain a new perspective on ourselves and the technological world that surrounds us.

Introduction

In today’s increasingly technological society, children, as well as adults, are surrounded and often saturated by “technology,” but rarely stop and ask ourselves how those tools affect us. Foucault breaks down the numerous technologies into four categories, relating to how they interact with the society and individuals: (a) technologies of production, (b) technologies of sign systems, (c) technologies of power, and (d) technologies of the self [1]. The first, the technologies of production, is perhaps what comes to the minds of most people when they hear “technology” – these are the technologies that allow us to produce, transform, and manipulate things. The technologies of sign systems refer to technologies that allow us to use signs, symbols, and form meanings. The third type, the technologies of power, determines the conduct of individuals and how they submit to certain dominations. It is of the last type, the technologies of the self, that we shall be concerned with in this paper. The technologies of the self, as defined by Foucault, are those technologies that “permits individuals to effect by their own means or with the help of others a certain number of operations on their own bodies and souls, thoughts, conduct, and way of being, so as to transform themselves in order to attain a certain state of happiness, purity, wisdom, perfection, or immortality [1].” A technology of the self positively impacts a person in some way such that the person can reflect and perceive the influence.

In this paper, we will examine ROBOLAB, a popular educational tool by LEGO Dacta, as a technology of the self. The benefits of ROBOLAB as a tool for teaching science, engineering, and programming to young children have been well documented and studied [2-4]. However, its
effects on the individual and the self have thus far been overlooked. In presenting ROBOLAB as a technology of the self, I will first give a brief background of the use of this technology as a science/engineering tool, and discuss its design philosophy from historical perspectives. I will then discuss ROBOLAB as a technology of the self, and end with some suggestions about how this technology can be adapted as an effective tool for children to examine the self.

The Technology as Science/Engineering Tool

ROBOLAB™ is an educational tool offered by LEGO Dacta (the educational division of LEGO), designed for hands-on learning of engineering and science concepts. The main components of the ROBOLAB system are the traditional LEGO bricks, the RCX programmable brick, and the ROBOLAB software. The traditional bricks are used to make structures, mechanisms, and robots. The students program the behavior of their design using the ROBOLAB software on a computer. The program is then transmitted to the RCX brick, which controls the LEGO creation. The RCX programmable brick act as an interface between the program, output options (motor, LED light), and input options (touch sensor, light sensor, temperature sensor, rotation sensor, camera, etc.). A consumer version of ROBOLAB is available as LEGO Mindstorms™, which also contains the RCX programmable brick for programming the LEGO constructions.

The software is organized into three levels: Pilot, Inventor, and Investigator. Children can begin learning with the Pilot program, which offers limited control of variables but is simple to learn. As they become more familiar with ROBOLAB software, they can seamlessly move into the next level, which offers more user control that comes with added complexity to the programming.

The applications of ROBOLAB™ are numerous, and are not limited just to robotics. For example, the system can be used to collect data from science experiments. It can also be used to teach many physics concepts. With an integrated LEGO camera, the system can be used to teach sophisticated concepts such as image processing and image recognition. The system can also be used to design and build real-life engineering projects.

As with all technology, its effectiveness in education and learning environments depend on how it is implemented. A general guiding principle for developing technology to promote learning was highlighted by Resnick [5], who lists two connections that must be made in order for a technology to create an effective learning environment: (a) personal connections to connect to
children’s interests and past experiences, and (b) epistemological connections to discover new ways of thinking and connect with different ideas. Projects using ROBOLAB make strong personal connections, because most children are familiar with the objects that they are using (i.e., LEGO bricks), and the project may be chosen to relate to the children’s interests. It also promotes epistemological connections by introducing programming and construction into other curriculum areas and letting children develop new ways of thinking. LEGO construction and ROBOLAB programming lets each child to draw from their knowledge of science, math, engineering, and their surroundings to develop creative solutions in his/her own ways. ROBOLAB also helps remove the fear of technology, science, and/or math that many children have by using simple, familiar objects (bricks) to solve problems.

Historical Perspective

To understand the philosophical background behind the development of ROBOLAB and Mindstorms, we will revisit Papert’s *Mindstorms* [6]. In the book, Papert discusses the notion of “objects-to-think-with,” which bridges children’s culture and knowledge to help construct identity. These objects are “carrier of powerful ideas and of the seeds of cultural change,” and can “help people form new relationships with knowledge that cut across the traditional lines separating humanities from sciences and knowledge of the self from both of these.”

This concept was the foundation under to the development of LEGO/Logo, where traditional LEGO brick constructions were combined with computing power of the Logo programming language. The ability for children to program and animate their LEGO constructions lead to a greater sense of personal investment, interest, and connection. With the success of the LEGO/Logo project, a collaboration was formed between the MIT Media Lab and LEGO Company, and the RCX programmable brick were developed [7]. The title of Papert’s book was later appropriately adapted as LEGO’s Mindstorms™ product line (which is the consumer version of ROBOLAB) when it first appeared in 1998. As with the original LEGO/Logo, Mindstorms and ROBOLAB adds motion and functionality to LEGO bricks by allowing children to program them. By doing so, it takes on Papert’s original vision behind programmable LEGO bricks. ROBOLAB becomes an “object-to-think-with,” allowing children to construct knowledge from self-guided projects that are relevant to their own lives.
ROBOLAB as a Technology of the Self

The two types of connections that were identified by Resnick – personal and epistemological connections – are further expanded into four tenets for constructionist approach to learning: (a) learning by designing, (b) integrating “objects-to-think-with,” (c) introducing powerful ideas, and (d) incorporating self-reflection [2]. ROBOLAB is an ideal medium for to incorporate these four elements into learning. We have already established that, when used effectively, ROBOLAB can an “object-to-think-with” – this has been the original design philosophy behind this technology. ROBOLAB can also bring powerful ideas – ideas that are relevant to the children that promote new ways of thinking. Learning by ROBOLAB is most typically learning by design, since children are constructing and programming LEGO bricks to solve a problem. The final point, self-reflection, is a key component in making ROBOLAB a technology of the self.

Self-reflection allows children to concretize the learning process that has just happened. The remarkable effect of ROBOLAB and the strong personal connections it makes with the children is that the children can enjoy the learning process. In an earlier study with LEGO/Logo, post-study interviews show many children expressing the experience as “hard, but fun [3].” Children expressing the learning process as “fun” is significant in several senses. First, it means that ROBOLAB has transformed science/math education into something positive, which is (unfortunately) often seen as a subject to be feared and avoided. Second, it opens up the possibility for the children that other “fun” activities can be a learning experience as well – that is, learning does not always happen in schools. Furthermore, completing a ROBOLAB project can give a powerful sense of accomplishment to children, particularly those who have not used computers before or those students who believed that they are not strong in math and science. This is even more true if the problem that the children studied had relevance in their personal lives or society. In addition to the science and math concepts, they also learn important principles such as the idea that making mistakes is just a part of the design process, and that there are multiple solutions to any problem. Through self-reflection, students realize that they have learned math, science, and/or science in an enjoyable experience, which will help inspire new confidence in those traditionally shunned subjects. Revisiting Foucault’s definition of the “technologies of the self,” ROBOLAB can impact children’s thought process regarding areas
such as science, engineering, math, and problem-solving, and through self-reflection, children can gain confidence to contribute more positively to our increasingly technological culture.

We have now seen how ROBOLAB can be regarded as a technology of the self in its traditional use in science/engineering curriculum. Now we shall examine how it can be adapted as a more effective tool for examining the self. In today’s society, it is easy for individuals to feel overwhelmed by the technologies that surround us. Many of us feel that the technology is out of our control, and it is a mysterious “black-box” that magically manipulates the world in ways that we do not understand. ROBOLAB can be a strong tool in reducing this sense of powerlessness and instilling a new sense of control and confidence to children (and even adults). Although its foundation is in the simple LEGO bricks, ROBOLAB is a powerful tool in solving real-life problems. For example, it is very simple to create a program that reads the light level of the surroundings and turn on a light bulb when it becomes dark. These simple projects allow children to gain a clearer understanding of the overwhelming technologies that are all around us. Such understanding is an important part of gaining a stronger sense of self. Seeing that the myriad of black-boxes that we encounter every day are all results of a logical process and a human-made design enable children to be better prepared to function in today’s society. This empowerment can be brought about by asking the children to create their own design projects using ROBOLAB that relate to improving the quality of his/her life or the society – that is, ideally, the driving force behind all technology – for example, how to make an automatic light switch for his/her own room. These projects will be relevant to the children, and will also enhance the understanding of how technology work. As described earlier, self-reflection is an important part of the process – children must think about how their ROBOLAB project is related to the real-life technology.

ROBOLAB can also be a tool for children to explore their identity and what is important to their being. This can be done through creating a LEGO environment to represent their surroundings. For example, a group of children can build a town using LEGO. The creations within this LEGO community can then be given functions using the computational power of ROBOLAB. Recreating one’s surroundings is an important aspect of self-reflection and identity formation [8]. Children who are building the town together can form a community to provide the interactions that are essential for forming a concrete sense of self. This activity lets children explore different
roles and identities within the town, which, through self-reflection, can lead to a stronger sense of self in the real life. It also gives children an opportunity to create their own space within the town – a house – where they can explore values and artifacts that are important to their lives.

Conclusion

LEGO Mindstorms™ and ROBOLAB™ were both created from Papert’s vision of “object-to-think-with” that was originally introduced in the book *Mindstorms*. Since its introduction in 1998, ROBOLAB has been adapted as an effective tool for science/engineering education for children of all ages. The learning philosophy behind the product is strictly constructionist, allowing children to design, make, program, and test robotic creations that are relevant to their personal culture. While engaged in this process, children learn about science, engineering, and design concepts that are academically relevant.

This product can also be considered a technology of the self, which impacts the self in some way and lead to some state of “happiness, purity, wisdom, perfection, or immortality [1].” ROBOLAB, if used in an appropriate project that is of relevance to the individual’s life and/or society, can be a powerful tool to demystify the technologies that surround us everyday. This understanding of the design process behind any technological black-box puts children in control of their surroundings.

In another example of use of ROBOLAB as a technology of the self, children can build virtual towns using LEGO and establish a community where they can interact with one another. This activity allows children to explore different roles and identities within the community, and reflect on their sense of self in the process.

Studies of ROBOLAB has thus far been focused on its scientific benefits. Now that its effectiveness has been proven for its academic values, the technology’s benefits to the child’s personal development should be examined. Papert’s goal for “objects-to-think-with” was for the technology to help form relationships across humanities and sciences, and the construct knowledge of the self. We have seen that ROBOLAB was effective in the first goal; we have yet to see research to show that the second goal has been realized.
References


