

Computer Clubhouses in the Inner City

Access Is Not Enough

Mitchell Resnick

At the clubhouse, I work with Lakesha. She is a mentor which means she knows a lot about computers. When she is not at the clubhouse, she is an engineer. She shows me how to do lots of fun things with computers like controlling LEGO robots. I want to learn about engineering in college.

—Latoya Perry, age 13



Illustration by J. T. Morrow

The New Media and Learning

With this issue we inaugurate a series of articles on the new media and learning, drawn from a conference sponsored by *The American Prospect* on June 4th at the MIT Media Laboratory.

The aim of the conference and the series is to explore whether the new technologies offer genuine promise for improvements in learning or are merely a diversion from the real problems of education, and to ask what approaches to policy and the new technologies hold the most promise. In addition to the authors of articles in this issue, the conference featured:

- Congressman Edward

<p>Markey of Massachusetts on why the Federal Communications Commission should adopt an "e-rate" under the Telecommunications Act of 1996 that would make a basic level of internet access free to schools;</p> <ul style="list-style-type: none"> • Mitchell Kapor, who served on the President's National Information Infrastructure Advisory Council before resigning in protest, on what went wrong with the NII initiative; • Seymour Papert on the use of computers for fundamental change in education; • Sherry Turkle on how learning about computers may affect our thinking about other things; and • Howard Gardner and Shirley Veenema on multimedia and new ideas about cognition and learning. <p>Audiotapes of the conference are available by calling 1-800-872-0162.</p> <p>Support for both the conference and publication of these articles comes from the Spencer Foundation of Chicago</p>	<p>Ever since the development of personal computers in the late 1970s, there have been growing concerns about inequities in access between technological haves and have-nots. Some groups have worked to close the gap by acquiring computers for inner-city schools. Others have opened community-access centers, where youth and adults alike from inner-city communities can use computers at little or no charge.</p> <p>The Computer Clubhouse of Boston, organized by the Computer Museum in collaboration with the MIT Media Laboratory, grows out of this tradition—but with important differences. At many other centers, the main goal is to teach young people basic computer techniques (such as keyboard and mouse skills) and basic computer applications (such as word processing). At the clubhouse, in contrast, the goal is for participants to learn to express themselves fluently with new technology.</p> <p>Fluency in a language involves not only a knowledge of basic vocabulary and grammar, but also the ability to articulate a complex idea or tell an engaging story. To be fluent, you must be able to "make things" with language. Analogously, technological fluency involves knowing not only basic techniques, but also how to make things of significance with them. A technologically fluent person should be able to go from the germ of an intuitive idea to the realization of a technological project. Increasingly, technological fluency is a prerequisite for jobs and full participation in our society.</p> <p>The Computer Clubhouse aims to help inner-city youth gain that type of technological fluency. The clubhouse is based not just on new technology, but on new ideas about learning and community. It represents a new kind of learning community where young people and adult mentors work together on projects, using technology to explore and experiment in new ways.</p>
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IMAGES OF A CLUBHOUSE

As co-founders of the Computer Clubhouse, we were involved from the very beginning. The first clubhouse was opened in 1993 in a 1,000-square-foot space on the ground floor of the Computer Museum in downtown Boston. During its first two years of operation, it attracted more than 1,000 young people ages 10 to 16, with 98 percent coming from underserved communities. Participants were from diverse cultural backgrounds, including African-American (61 percent), Asian (13 percent), and Latino (11 percent). To attract participants, the clubhouse initially established connections with community centers and housing projects in target communities; since then, it has

relied primarily on word of mouth. Youth do not have to sign up for time at the clubhouse; they can drop in whenever it is open.

At the clubhouse, young people become designers and creators—not just consumers—of computer-based products. Participants use leading-edge software to create their own artwork, animations, simulations, multimedia presentations, virtual worlds, musical creations, Web sites, and robotic constructions.

What does the clubhouse learning community look like? Here are some quick "snapshots."

- Binh moved to the United States from Vietnam three years ago. He and his friend Liem learned from clubhouse staff how to build a computer interface to control motors. Binh and Liem are now showing other clubhouse members how to build interfaces to control such motorized devices as robot arms and toy dune buggies.
- Essam, a ninth grader from Roxbury, designs and programs his own computer games at the clubhouse. He usually uses the Logo programming language, but Michael, a student from Wentworth Institute, is mentoring him to program in C, a professional programming language that Essam wanted to learn. Essam's work has attracted the interest of other clubhouse participants, and he is in turn helping other youth learn to design and program their own games. Michael is also gaining confidence and learning from his experience as a mentor.
- Sandi is developing an interactive multimedia project for an independent study course at her school. She chose to research the history of Native Americans to learn more about her heritage. Her project combines text, graphics, photographs, and sound. Sandi's teachers are impressed by what she has produced, and they hope that more of their students will start producing multimedia reports.
- Emilio saw a laser-light show at another museum and wants to create something similar at the clubhouse. He glues small mirrors onto a few LEGO motors, writes a short computer program to control the motion of the motors, and bounces a laser light off of the mirrors to create wonderful Lissajous-like patterns. Throughout the project, Emilio is involved in mathematical thinking, modifying angles and speeds to create new laser patterns.
- Several clubhouse members are creating the Online Art Gallery on the World Wide Web. Once a week, they meet with a local artist who has agreed to be a mentor for the project. After a year, their online art show was accepted as an exhibition at SIGGRAPH, the premiere computer-graphics conference.
- Paul's art teacher recommended he visit the clubhouse, just two weeks after Paul moved to Boston from Trinidad. Paul had always enjoyed drawing but had never used a computer before coming to the clubhouse. He now comes to the clubhouse three or four days a week. Last summer, based on his clubhouse experiences, Paul got a job designing Web pages for a local company. He designed a series of original character drawings, and he reliably met demanding deadlines. Now Paul is interested in pursuing a college program in computer animation and graphic design.

CLUBHOUSE PRINCIPLES

The development of the clubhouse learning environment has been guided by four core principles:

Principle 1: Support learning through design experiences. Activities at the clubhouse vary widely, from constructing and controlling LEGO robots to orchestrating virtual dancers. But these varied activities are based on a common framework: engaging youth in learning through design.

In recent years, a growing number of researchers and educators have argued that design projects provide rich opportunities for learning. Design activities engage youth as active participants, giving them a greater sense of control over and responsibility for the learning process, in contrast to traditional school activities in which teachers aim to "transmit" new information to the students. Design also encourages creative problem solving and fosters a search for multiple strategies and solutions, instead of the focus on getting one right answer that prevails in most school math and science activities. Design projects are often interdisciplinary, bringing together concepts from the arts as well as math and sciences.

Design activities, moreover, can create personal connections to knowledge, since designers often develop a special sense of ownership (and caring) for the products and ideas that they design. Yet design also promotes a sense of audience, encouraging youth to consider how other people will use and react to the products they create. And design projects provide a context for reflection and discussion, enabling youth to gain a deeper understanding of the ideas underlying hands-on activities.

This emphasis on design activities is part of a broader educational philosophy that MIT professor Seymour Papert has termed "constructionism." Constructionism is based on two types of "construction." First, it asserts that learning is an active process, in which people actively construct knowledge from their experiences in the world. People don't get ideas; they make them. (This idea is based on the "constructivist" theories of Jean Piaget.) And, second, people construct new knowledge with particular effectiveness when what they make is personally meaningful.

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At the clubhouse, construction takes many forms. Rather than playing computer games, clubhouse participants create their own computer games. And rather than just "surfing" on the Internet's World Wide Web, participants make waves: They create their own multimedia Web pages, such as the clubhouse's Online Art Gallery.

To support these activities, the clubhouse provides a variety of design tools, from introductory paint programs (such as KidPix) to high-end animation tools (such as Director). Other software tools include digital music recording, editing, and mixing tools; desktop publishing tools; programming tools (such as Microworlds Logo); virtual-reality design tools for developing three-dimensional models on the computer screen; and construction kits for creating and controlling robotic machines (such as LEGO Control Lab). The clubhouse also serves as a testbed for new technologies under development at research universities and companies. For example, the clubhouse was the initial test site for the Programmable Brick, a portable tiny computer built into a LEGO brick, developed at the MIT Media Lab.

At the clubhouse, youth learn how to use these tools. But even more, they learn how to express themselves through these tools. They learn not only the technical details, but the heuristics of being a good designer: how to conceptualize a project, how to make use of the materials available, how to persist and find alternatives when things go wrong, and how to view a project through the eyes of others. In short, they learn how to manage a complex project from start to finish.

The design tools at the clubhouse were chosen, in part, because they connect with children's imaginations and interests. But at the same time, these tools connect with important mathematical and scientific concepts. The tools don't directly teach mathematical and scientific ideas; rather, youth use (and learn) these ideas as an integral part of their design projects. For example, as clubhouse youth work on robotics projects with LEGO/Logo (a computer-controlled construction kit) and the Programmable Brick, they naturally engage in thinking about such scientific concepts as mechanical advantage and feedback. And as students work on computer art projects, they need to develop a working understanding of scaling, perspective, and symmetry.

Principle 2: Help youth build on their own interests. In schools of education, the focus is usually on methods of teaching, not motivations for learning. Many courses emphasize how and what teachers should teach, but seldom examine why their students might want to learn. When the issue of motivation is addressed, the emphasis is often on extrinsic motivators and incentives, such as grades and prizes based on performance.

Yet if you look outside of school, you can find many examples of people learning—and learning well—without explicit rewards. Youth who seem to have short attention spans in school often display great concentration on projects that truly interest them. They may spend hours learning to play the guitar or play basketball. Their interests are a great untapped resource—untapped, that is, in school. As Roger Schank, a professor at Northwestern University, has written, "An interest is a terrible thing to waste."

When youth care about what they are working on, the dynamic of teaching changes. Rather than being "pushed" to learn, youth work on their own and seek out ideas and advice. Youth are not only more motivated but also develop deeper understandings. Pursuing any topic in depth can lead to connections to other subjects and disciplines. The educational challenge is to find ways to help youth make those connections and develop them more fully. For example, an interest in riding a bicycle can lead to investigations of gearing, the physics of balancing, the historical evolution of vehicles, or the environmental effects of different forms of transportation.

The clubhouse is designed to support youth in developing their interests. While youth from middle-class households generally have many opportunities to build on their interests (music lessons, specialty camps, and so on), most clubhouse participants have no other constructive after-school options. And many do not even have a clear sense of their interests, let alone how to build on them.

Clubhouse participants are encouraged to make their own choices. All of the youth at the clubhouse have chosen to be there, and they can come and go as they please. At the clubhouse, participants continually confront choices about what to do, how to do it, and whom to work with. The clubhouse helps these youth gain experience with self-directed learning, helping them recognize, trust, develop, and deepen their own interests and talents.

Helping youth develop their interests is not just a matter of letting them do what they want. Young people must be given the freedom to follow their fantasies but also the support to make those fantasies come to life. On the walls, shelves, and hard drives of the clubhouse, there is a large collection of sample projects, designed to provide participants with a sense of the possible and with multiple entry points for getting started. In one corner of the clubhouse is a library of books, magazines, and manuals filled with more project ideas (and a sofa to make reading more comfortable). Many youth begin by mimicking a sample project, then work on variations on the theme, and soon develop their own path.

This approach works only if the environment supports a great diversity of possible projects and directions. The computer plays a key role here. The computer is a "universal machine" that supports design projects in many different domains: music, art, science, math. At any time, two participants might be using a computer to create a graphic animation, while at the next computer another youth might be using a similar computer to control a robotic construction.

Of course, the technology alone does not ensure diversity. In schools, more teachers are beginning to include design experiences in their classroom activities. But in many cases, these design activities are very restrictive. Students do little more than follow someone else's recipe. In classes working with LEGO/Logo, students are often told precisely how and what to build. For example, a teacher might instruct every student to build the exact same LEGO car, using the same bricks, gears, and wheels and the same computer program to control it. The clubhouse, in contrast, has the feel of an invention workshop. Working with LEGO/Logo, clubhouse youth have built, programmed, and experimented with a wide assortment of projects, from an automated hair curler to a computer-controlled LEGO city. The LEGO materials and computer technology allow this diversity—even more important, the clubhouse community supports and encourages it.

Principle 3: Cultivate "emergent community." How do people learn to speak a language? Many American students take several years of French in high school but still can't communicate fluently. The language is learned best by actually living in France and participating in the culture—by going to the store to buy a baguette, joking with the vendor who sells *Le Monde*, overhearing conversations in the café. To become technologically fluent, young people need a similar type of immersion. They need to live in a "digital community," interacting not only with technology, but with people who know how to explore, experiment, and express themselves with the technology.

To foster this type of community, the Computer Clubhouse includes a culturally diverse team of adult mentors—professionals and college students in art, music, science, and technology. Mentors act as coaches, catalysts, and consultants, bringing new project ideas to the clubhouse. Most mentors volunteer their time. On a typical day, there are two or three mentors at the clubhouse. For example, clubhouse participants might be working with engineers on robotics projects, artists on graphics and animation projects, programmers on interactive games. For youth who have never talked to an adult in academic or professional careers, this opportunity may be a pivotal experience.

In this way, the clubhouse deals with the "access issue" at a deeper level. Inner-city youth need access not only to machines, but to people using technology in interesting ways. This type of access is not possible in a classroom with 30 children and a single teacher. The clubhouse takes advantage of an untapped local resource, providing a new way for people in the community to share their skills with local youth.

By involving mentors, the clubhouse provides inner-city youth with a rare opportunity to see adults working on projects. Mentors do not simply provide "support" or "help"; many work on their own projects and encourage clubhouse youth to join in. John Holt, the author of several influential books about education, argues that children learn best from adults who are working on things that they themselves care about. Holt writes, "I'm not going to take up painting in the hope that, seeing me, children will get interested in painting. Let people who already like to paint, paint where children can see them."

To become good learners, young people should observe adults learning. But that is rarely the case in schools. Teachers often avoid situations where students will see them learning: They don't want students to see their lack of knowledge. At the clubhouse, however, youth catch adults in the act of learning and, for some clubhouse participants, it is quite a shock. Several clubhouse participants were startled one day when a clubhouse staff member, after debugging a tricky programming problem, exclaimed: "I just learned something!"

Projects at the clubhouse grow and evolve. A mentor might start with one idea, a few youth will join for a while, then a few others will start working on a related project. For example, two graduate students from Boston University decided to start a new robotics project at the clubhouse. For several days, they worked on their own; none of the youth seemed particularly interested. But as the project began to take shape, a few youth took notice. One decided to build a new structure to fit on top of the robot, another saw the project as an opportunity to learn about programming. After a month, a small team was working on several robots. Some youth were integrally involved, working on the project every day. Others chipped in from time to time, moving in and out of the project. The process allowed different participants to contribute to different degrees—a process that some researchers call "legitimate peripheral participation."

This approach to collaboration is strikingly different from what occurs in most classrooms. In recent years, there has been a surge of interest among educators in "collaborative learning" and "communities of learners." In many schools, students work in teams to solve problems. Often, each student is assigned a distinct role in the collaborative effort. At the clubhouse, collaboration has a different flavor. No one is assigned to work on any particular team. Rather, communities "emerge" over time. Design teams form informally, coalescing around common interests. Communities are dynamic and flexible, evolving to meet the needs of the project and the interests of the participants. A large green table in the middle of the clubhouse acts as a type of village common, where people come together to share ideas, visions, and information (not to mention food).

As youth become more fluent with the technologies at the clubhouse, they too start to act as mentors. During the first year of the clubhouse, a group of six youth emerged as regulars, coming to the clubhouse nearly every day (even on days when it was officially closed). Over time, these participants began to take on more mentoring roles, helping introduce newcomers to the equipment, projects, and ideas of the clubhouse.

Mike Lee, one of the earliest clubhouse participants, quickly emerged as a mentor to other youth. Mike had enjoyed drawing comic-book characters ever since he was a young child, but he had no experience with computer graphics until he came to the clubhouse. To get started, he scanned in some of his black-and-white sketches, then used the computer to color them in. Everyone in the clubhouse was impressed with Mike's artwork, and other youth began to come to him for advice, and started mimicking his approach. Before long, a collection of "Mike Lee style" artwork filled the

bulletin boards of the clubhouse. Mike recognized his role as a mentor to younger clubhouse participants, and took the responsibility seriously. For example, he decided to stop using guns in his artwork, feeling that it was a bad influence on the younger clubhouse members.

While serving as a mentor, Mike also learned from others. At first, he worked only on comic-book characters. Over time, he began to experiment with artistic ideas that he saw in other clubhouse art. He began to add more computer effects, while maintaining his distinctive style. Eventually, he expanded beyond static images, creating his own computer animations. After a year, Mike used his clubhouse experience to get a job designing online graphics for a local consulting company—a job he wouldn't have dreamed of getting a year earlier.

Principle 4: Create an environment of respect and trust. When visitors walk into the clubhouse, they are often amazed at the artistic creations and the technical abilities of clubhouse participants. But just as often, they are struck by how clubhouse youth interact with one another. The clubhouse approach puts a high priority on developing a culture of respect and trust. These values not only make the clubhouse an inviting place to spend time but are also essential for enabling clubhouse youth to try out new ideas, take risks, follow their interests, and develop fluency with new technologies.

There are many dimensions to "respect" at the clubhouse: respect for people, respect for ideas, respect for the tools and equipment. Mentors and staff set the tone by treating clubhouse youth with respect. Right from the start, participants are given access to expensive equipment and encouraged to develop their own ideas. "You mean I can use this?" is a common question for youth to ask when they first visit the clubhouse.

Even with all these options, youth won't take advantage of the opportunities unless they feel "safe" to try out new ideas. In many settings, they are reluctant to do so, for fear of being judged or even ridiculed. At the clubhouse, no one gets criticized for mistakes or "silly" ideas; it is understood that ideas (and people) need time to develop. One new clubhouse participant spent weeks manipulating a few images, over and over. But then, like a toddler who is late learning to talk but then starts speaking in full sentences, he suddenly started using these images to create spectacular graphic animations.

Clubhouse youth are given lots of choice, but with this freedom come high standards and high expectations. Clubhouse staff and mentors do not simply dole out praise to improve the self-esteem of the youth. They treat youth more like colleagues, giving them genuine feedback and pushing them to consider new possibilities. They are always asking: What could you do next? What other ideas do you have? Many clubhouse youth thus learn not only new computer skills, but also new styles of interaction. Treated with respect and trust, they are expected to treat others the same way.

THE INTERNET AS RORSCHACH

As new technologies arise, these clubhouse principles can serve as important guideposts. Today, public discussion about the role of technology in education focuses on the Internet. As the Internet plays an ever-growing role in commerce and social life, there are concerns that people without access will be left behind. California's highly publicized NetDay in February 1996 (when thousands

of volunteers helped set up network connections at elementary and secondary schools) was one effort to broaden access to the Internet. Many other states are now following suit with NetDays of their own.

But access to the Internet, like access to computers, is not in itself enough to create substantial change in the lives and learning of children. The Internet can be used in a wide variety of ways—and with radically different results. A decade ago, Sherry Turkle argued that computers serve as a Rorschach test: How people view computers reveals much about their views on other things. Today, the Internet serves as a type of Rorschach test of educational philosophy.

Some people see the Internet as a new way to deliver information. They explain how lectures by expert scientists could be beamed down to thousands of schools. They imagine the day when personal work stations will give problems to students, monitor student progress on the problems, and automatically download video segments from network servers at appropriate times during the instruction.

When other people look at the Net, they see a huge database for students to explore. They dismiss the idea of delivering information to students across the network. They want to turn the tables, putting students in control of the information. They talk about new tools that allow students to search through thousands of servers on the Net, locating information that they are interested in.

The clubhouse philosophy suggests a third, very different, vision of the Internet. We see the Internet as a new medium for collaborative construction—a new opportunity for students to discuss, share, and collaborate on constructions. We would like to see youth use the Internet to create and share new types of simulations and animated stories. For example, youth could use the Net to collaboratively create an ocean ecosystem, with each person programming the behavior of an "artificial fish"—then discussing with one another the systems-level phenomena that arise from the interactions. Through these activities, students could develop an understanding of certain scientific phenomena (such as feedback and self-organization) that are usually studied only at the university level, using advanced mathematical techniques.

Each of these visions of the Net reflects a different educational philosophy. The first vision sees education as instruction: If we could just "deliver" better instruction, we would have better education. The second and third visions are more "learner centered," based on the belief that people actively construct knowledge from their experiences and explorations. In the second view, if we can provide better environments for explorations, people can learn more. The third vision (the clubhouse vision) puts a special emphasis on design and construction activities, based on the belief that people construct knowledge with particular effectiveness when they are actively engaged in constructing meaningful artifacts. In this vision, the Internet brings together ideas of community and construction, enabling people to engage in a new range of collaborative design activities.

BEYOND RODIN

When people think about thinking, they often imagine Rodin's famous sculpture *The Thinker*. Rodin's *Thinker* is a solitary individual, sitting by himself, with his head resting on his hand. This

image seems to say: If you just sit by yourself quietly and concentrate hard, you will do your best thinking.

But that image provides a restricted view with dwindling relevance to today's digital world. In recent years, there has been a growing recognition that thinking usually happens through interactions with other people, often aided by media and technology. New media and technologies support new representations of knowledge, which in turn open up new ways of thinking about problems.

The clubhouse helps young people become fluent with these new "tools for thought." Two product managers from Adobe, a leading software company, spent several days at the clubhouse, hoping to gain insights on how they might change and improve their products. Afterward one of them wrote:

We were amazed at the incredible rate the kids learned complex products such as Photoshop and Director and how they used the software almost as an extension of themselves. The kids seem to have a lot more enthusiasm and creativity in the work since they choose their own projects and determine for themselves what they want to do. I liked how the more experienced members trained the new members how to do things and how they took responsibility for the computers and their setups. Clearly the Clubhouse is their clubhouse, not someone else's place.

These comments capture some of the core ideas underlying the clubhouse approach: young people working on design projects, following their own interests, developing fluency with new technologies, sharing knowledge as members of a community, and becoming self-confident as learners.

Of course, creating this type of learning environment isn't easy. At times, the clubhouse might seem chaotic. It takes trust and patience to allow youth to follow their own interests. But the clubhouse should not be seen as unstructured: Although youth have great freedom in choosing their projects, there is structure embedded in the design of the materials, space, and community. Through its choice of mentors, sample projects, and software tools, the clubhouse provides a framework in which rewarding learning experiences are likely to develop.

The clubhouse's long-term goal is to make these types of experiences available to youth in many more low-income neighborhoods. We are currently establishing a nationwide network of Computer Clubhouses. As part of this effort, we are developing workshops and materials to help other sites start their own clubhouses. In addition, we are creating the infrastructure for network-based interaction among the sites, so that youth at different clubhouses can collaborate on joint design projects, and mentors and staff can share ideas with one another. Ideally, these new clubhouses will serve as models for a new approach to technology, learning, and community—while giving youth who most need it the opportunity to build futures of their own.

[Bibliography](#)

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