Integration of Computers into the Montessori Curriculum

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CS294, Human Centered Computing
Fall, 1999

What is Montessori?

> "In the special environment prepared ... in our schools, the children themselves found a sentence that expresses the inner need: 'Help me to do it by myself!'"
> Maria Montessori, *The Secret of Childhood*

Montessori is a philosophy of education originated by Maria Montessori in Italy in the early 1900's. Born in 1870, Montessori became Italy's first woman physician and surgeon in 1896. During her years of practicing as a doctor, she had the opportunity to work with children and make observations about how they learn. In 1906, she left medicine to put into practice the theories she had developed about teaching. She opened *Casa dei Bambini*, or "House of Children", where she implemented what is now known as the Montessori Method.

Montessori's philosophy can be summed up in one simple sentence: "Children teach themselves." She said that children have "absorbent minds", and are driven to build order out of the chaos they perceive in a world full of sights and sounds. She believed, as do current practitioners of the Montessori Method, that if children are given an appropriately stimulating setting, they will learn for themselves. She felt that her job was to provide that setting, which she called the "prepared environment". The "prepared environment" consists of ordered, sequential learning materials. These materials must be clean, bright, and in excellent repair in order to be engaging to the children. The children must yearn to take them off the shelves (all placed at appropriate heights so that the children can reach them without assistance), touch them, and learn with them. The quintessential Montessori materials are the bead bars. They are made up of small ceramic beads strung on copper wire and glazed with bright, beautiful colors. They are smooth to the touch. The red units, green twos, pink threes, yellow fours, light blue fives, lavender sixes, white sevens, brown eights, blue nines and golden tens are the basis of the math materials for learning everything from counting to quadratic functions. The golden tens are further used to teach the decimal system. By using these materials rather than pencil and paper, children acquire a kinesthetic and intuitive knowledge of math. Instead of knowing that "1" means one, they have a knowledge of one, of its essence. There are also Montessori materials also for Language, Geometry, History, Botany, Zoology, Fractions, Geography and Practical Life. Practical Life is daily skills that are necessary to learn: tying ones shoes, slicing apples, setting the table, etc. Another part of Montessori is learning respect – for oneself, ones classmates, adults, the environment, etc. One way this is taught is through the use of rugs. When a child is about to being a new job, he first lays out a rug on the floor. He then proceeds to use the materials on the rug. If the job is large, more than one rug may be necessary. The other children are careful not to step on his rug or to disturb his work. He, in turn, is respectful of the other children's rugs. The rug is basically a way of making the concept of personal space

concrete. In all, the prepared environment is supposed to offer the opportunity for children to ask questions and find the answers for themselves.

Montessori developed her method for all of the developmental planes, as she saw them:
− birth to 6 years, when children are engaged in sensorial exploration
− 6-12 years, when they learn through conceptual exploration
− 12-18 years, a time when they undergo humanistic exploration
− 18-24 years, when they specialize
The Montessori Method is best known for preschool education.

Maria Montessori believed that world peace could be achieved through education, and she was nominated for the Nobel Peace Prize three times: in 1949, 1950 and 1951 before her death in 1952.

Current Uses of Computers in Montessori Classrooms

"Computers are not good or bad. They are powerful."
Sherry Turkle, *The Second Self: Computers and the Human Spirit*

Computers are used in a variety of ways in Montessori classrooms. Research into the subject first of all yielded arguments for and against using them at all. One article advocating the use of the Internet in Montessori classrooms (Roddy, 1997) states that the World Wide Web can support the constructivist learning process as a research tool, allowing children to formulate questions and then find the answers themselves. Additionally, the Web encourages children to go directly to the source of information and ask questions of the experts. For example, the Volcano World homepage at http://volcano.und.nodak.edu had an "Ask the Volcanologist" feature. (It has been discontinued since the publication of the cited article.) Newsgroups are another source of information for Montessori students. Another advantage of the Internet in the Montessori environment is the ability of students to communicate with a far larger variety of people than was possible before the Internet age. With video conferencing, students can interact with people all over the world, trading ideas and understandings.

Another article (Turner, 1992) opposes the use of computers in Montessori classrooms.   Turner wonders whether computers in the classroom are to learn *about*, *through*, or *by way of*. She sees computer-assisted instruction as an attempt to have computers program the child. She cites Seymour Papert as someone who proposes, instead, that the children learn to program the computer. She believes that this is a bad idea because programming can only teach a data processing model of procedural thinking. She also expresses concern that children who are preoccupied with programming will lose touch with reality. Another criticism of computers in the classroom is that they provide too much data, without providing a framework for it. She stresses that while children need and like data, they need to acquire it themselves, firsthand. When parents argue that their child loves working on the

computer, and that the Montessori philosophy is to "follow the child", her rebuttal is that it is up to the adults to provide only "good" choices.

In order to find how computers are currently being used in Montessori, I read articles on the subject, I interviewed Montessori teachers, and I drew on my own experience. The following are uses of computers in Montessori: practical life, drills, phonetics, research, games, word processing, Logo/MicroWorlds, simulation of Montessori materials and educational research.

In practical life, children are exposed to computers as a tool that it will be necessary for them to acquire a competency with in order to succeed in the world. Drill and phonetics software applications attempt to make rote memorization, or skills that take a lot of practice, fun. This is done by turning it into a game, or simply by virtue of being on the computer. An example of a drill program is MathBlaster, where the child answers math "facts" as fast as possible in order to shoot down alien ships. The games found in the classroom include SimAnt, where a simulation of an anthill is built, and a game based on Sun Tzu's *The Art of War.* Children whose fine motor and writing skills lag behind their creativity have utilized word processing programs with great success. Logo/MicroWorlds was designed specifically with a Montessori-like constructivist philosophy in mind. The purpose of MicroWorlds is precisely to allow the child to explore worlds to which he has no other access, for example a world where Newtonian physics makes intuitive sense. The child can then build on this intuitive understanding, making more and more complex MicroWorlds. This closely mirrors the ordered, sequential learning of the Montessori Method. Simulations of the Montessori materials are applications for the desktop computer that are an extension of the lessons learned with the physical materials. The jobs are the same, but on the computer monitor in two dimensions, and manipulated with the mouse and keyboard.

Additionally, a great deal of fieldwork in education research has been done in Montessori classrooms. The reason for this was never explicitly stated in the papers I read, but I suspect it has to do with the independent and flexible nature of the Montessori environment. One of the more interesting studies, in terms of computers in Montessori classrooms, was a study on a application called "Kid's Space" (Meskill, 1996). Response-based theory as it applies to reading is that the readers are actively creating interpretations for what they read, based on their personal experiences. In a response-based framework, the teacher acts as a facilitator. Because student-generated ideas and questions are at the center of learning, it was possible to develop a computer application that facilitated constructing worlds, exploring other children's worlds, and sharing about each other's work.

Evaluation of Current Uses

When I began researching this project, I hypothesized that most uses of computers in the Montessori classroom would be the same as uses in more "traditional" classrooms. This theory seems to have been upheld by the

information I have gathered. With the exception of the Montessori material simulations, none of the uses I came across were unique to Montessori. Even the educational research studies that were conducted in Montessori classrooms were conducted in traditional classrooms as well.

The uses of computers in the Montessori classroom generally fall into three categories: those that work well in the Montessori environment, those that have some redeeming value, and those that have none.

Some of the uses of computers in the Montessori classroom are excellent. They both have educational value and are well integrated with the Montessori philosophy. Among these are Logo/MicroWorlds, "Kid's Space", and research. As already discussed, Logo and MicroWorlds invite constructivist learning, and enable sequential learning. "Kid's Space" encourages children to explore ideas for themselves, without the interpretations of adults. Additionally, they can share their thoughts with their classmates. There are some problems with both of these programs: Logo can be difficult for the teacher to learn, and, similarly, not all teachers in the study used "Kid's Space" as intended. With extensive teacher training, both in the use of the applications, and in how they relate to Montessori, both of these applications could be extremely effective in the Montessori classroom. Using the World Wide Web and CD-ROMs for research purposes merges well with the Montessori environment. Children are already encouraged to ask questions and seek answers through books, adults, or other resources. The Internet merely provides them with access to more information. Naturally, caution must be used when having a computer in the classroom that is hooked up to the Internet. I do not believe that any really good solution to this problem has been implemented.

The majority of computer applications used in Montessori classrooms fall into the mediocre category. Many drill programs are successful in helping children memorize math facts, if they are engaging enough. However, the Montessori curriculum already has fact memorization materials incorporated. The same goes for phonetics applications. Word processing and drawing programs are great, and children enjoy using them to create stories and pictures. The drawing programs can give them confidence, as they are able to create a perfect circle, or a straight line; word processors relieve the child of the need to painstakingly print each letter in a story. One teacher I spoke with (King, personal communication) takes a "shotgun" approach to educational software. He purchases everything that comes onto the market and briefly evaluates it himself. Assuming he deems it to have some educational value, he installs it on the computers in his classroom. He then leaves it up the students to decided whether they are worthwhile applications. This is a very Montessori approach to the problem of finding suitable software for the classroom, as it "follows the child".

Then there are the uses of computers that have no place in a Montessori classroom whatsoever. The program in this category that seems to appear most often is MathBlaster. As the goal of the game is to destroy alien ships, it clearly advocates violence. Additionally, because it is so like a video game, many students will tend to want to spend all of their time playing it. This is the same

reason that I do not believe that games belong in the Montessori classroom at all. SimAnt is another example of a game that was being used. It could be argued (indeed, was argued) that it is educational, and teaches about ants. However, children could learn far more about ants by going outside and observing them, or by building a real ant farm. Unfortunately, the only Montessori-specific application I found, simulation of the Montessori materials, is completely un-Montessori. By simulating the materials on a computer, their kinesthetic and sensorial value is completely removed. By far, however, the most egregiously inappropriate computer program I ever saw running in a classroom was a game based on Sun Tzu's *Art of War*. Maria Montessori believed in world peace through education, and therefore the *Art of War* is clearly unacceptable in a Montessori classroom. I have no idea what the goal of the game is, as I uninstalled it my first day teaching in that classroom.

Proposed Use of Information Appliances

One noteworthy observation is that all of the uses of computers mentioned so far have been computer software applications designed for the PC or Mac. With the current explosion of computers into our cars, our telephones, our TVs, our toys, and the palms of our hands, I propose that we expand them into the Montessori classroom. The traditional model of a computer – the computer, keyboard, mouse, and peripherals, has been firmly established in the Montessori environment, though peripheral itself. I suggest that the Montessori materials be made, themselves, into information appliances. They would retain the "look and feel" of the materials that have been successful for decades, but they would have some enhancement by virtue of being computers. Originally, I thought to use the computer to provide feedback to the child. However, the materials are already designed to provide all the necessary feedback, and Montessori learning is meant to be process, not goal oriented. I believe that the best use of computers as Montessori materials is for tracking and keep records of the individual child's progress. Of course, the teacher observes the children, but, equally obviously, is unable to watch every child at all times. My suggestion is that all of the materials be made into wireless devices that communicate with the rug, also a computer. The rug will be aware of which child is working, what job is being performed, and will track each move the child makes with the materials. This way, the teacher can review the child's performance at his leisure, and is able to observe exactly how a child is doing on a certain task without having to actually watch the child. This is advantageous for several reasons:

– A child may behave differently when the teacher is watching
– The teacher can not observe all children at all times, as previously noted
– Parents can be shown exactly what and how their child is doing
– If a child is having difficulty, the teacher can pinpoint exactly what the problem is
– The teacher can better gauge a child's progress, and whether he is ready for the next step in the sequential learning

Generally, I believe that the more information a teacher has about his students, the more effective he can be. I am certainly aware that the vast majority of the data recorded will never be used, but data storage is cheap, and the benefits numerous.

Foreseeable Obstacles

There are many obstacles that need to be overcome before information appliances as Montessori materials become a reality. The first is the limitations of existing technology. These appliances as I have described them will have to have very tiny hardware, in order to fit into many of the materials, such as the bead bars. Additionally, they will need to have a very long battery life, and they will have to be quite durable and reliable. While this technology is not yet readily available, it soon will be.

The next obvious obstacle is expense. When this technology does become available, it will, as with all new technologies, most likely be extremely expensive. However, again as with other new technologies, the cost will decrease as the newness wears off.

The greatest barrier to the success of this idea is the Montessori teachers themselves. When I was interviewing teachers, the response to this idea was very negative. The biggest problem was that I was unable to get the teachers to understand what I was proposing. The model of the desktop computer is so ingrained that they could not comprehend the concept of an information appliance. One teacher I spoke with (King, personal communication) used to be an engineer, so I expected him to be more open to the idea. He was the most firmly against it. His reasons included expense, reliability, ease of use and, surprisingly, concern about making the teacher redundant. I must say that I do not believe that any of the teachers I spoke with had a clear understanding of what I was suggesting.

The Future

Future work on this idea would require several very different tasks. It will be necessary to do extensive interviews of Montessori teachers. Before this can be done, I must figure out how best to communicate my idea to people who are not technologically inclined. Suggestions are to use the word "gadget" as opposed to "computer", and to present scenarios of how the materials might be used. Additionally, the materials will have to be prototyped and comprehensive user testing performed. I believe that this is a viable idea and plan to explore it further.

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