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The MediaMOO Project: Constructionism and Professional Community

Amy Bruckman and Mitchel Resnick
MIT Media Lab, E15-315a
20 Ames St.
Cambridge, MA 02139
USA
asb@media.mit.edu mres@media.mit.edu

ABSTRACT

MediaMOO is a text-based, networked, virtual reality environment designed to enhance professional community among media researchers. MediaMOO officially opened on January, 20th, 1993, and as of December 1994 has more than 1000 members from 29 countries. An application is required to join, and only those actively engaged in media research are admitted.

Unlike many virtual environments, the world of MediaMOO is continuously being constructed and reconstructed by its members. This paper analyzes experience with the system to date, and highlights the importance of "constructionist" principles in virtual reality design. The philosophy of constructionism argues that people learn with particular effectiveness when they are engaged in constructing personally meaningful projects; learning by doing is better than learning by being told. This approach is most often applied to children's learning. We believe that not enough attention is paid to its broader applicability. We have found that letting the users build a virtual world rather than merely interact with a pre-designed world gives them an opportunity for self expression, encourages diversity, and leads to a meaningful engagement of participants and enhanced sense of community.

Keywords: virtual community, MUDs, constructionism.

1. Virtual Professional Community

Once or twice a year we stand with name badges sipping coffee in a corridor, exchange ideas over expense-accounted lunches, and maybe attend a few talks. Friendships are made and projects hatched. Then it's back home to file for expenses, perhaps write a trip report, and get back to "real work" and relative isolation.

MediaMOO is a text-based, networked, virtual reality environment designed to extend the type of casual collaboration which occurs at conferences to a daily activity. Visitors to a conference share not just a set of interests, but also a place and a set of activities. Interaction is generated as much by the latter two as the former:

Person A: Can you tell me how to get to Ballroom A?
Person B: I'm headed that way now. It's up this way.
Person A: Thanks!
Person B: I see you're at Company X....

Person C: Is this seat taken?
Person D: No, it isn't.
Person C: I'm surprised the room is so packed.

Person D: Well, Y is a really good speaker....

A text-based virtual environment can provide both a shared place (the virtual world), and a shared set of activities (exploring and extending the virtual world). Like at a coffee break at a conference, there is a social convention that it is appropriate to strike up a conversation with strangers simply based on their name tags. On MediaMOO, you can read descriptions of people's research interests as well as their names, and this can form a basis for striking up a substantive conversation.

However, name tags alone are not enough. The best sorts of interactions occur when people participate in a shared activity and not just a shared context. On MediaMOO, this takes the form of constructing and interacting with the virtual world. The constructionist theory of learning emphasizes the value of constructing personally meaningful artifacts[1, 2]. This theory has guided design decisions made in MediaMOO. For example, in most text-based virtual reality environments, the privilege to extend the virtual world is restricted to a small number of users. Everyone in MediaMOO is automatically a programmer with full privileges to create new objects and places in the virtual world.

This paper has two main goals. First, it documents experience with the MediaMOO project to date and evaluates its success as a virtual professional community. Second, it explores the application of constructionist principles to virtual reality design.

2. What is MediaMOO?

MediaMOO is a text-based, networked virtual reality environment or "MUD"[3-5] running on the Internet. Its basic structure is a representation of the MIT Media Lab. Users connect in the LEGO Closet, and then step out into the E&L (Epistemology and Learning research group) Garden:

```
> connect guest
*** Connected ***
The LEGO Closet

It's dark in here, and there are little crunchy plastic
things under your feet!  Groping around, you discover
what feels like a doorknob on one wall.

Obvious exits: out to The E&L Garden

> out
The E&L Garden

The E&L Garden is a happy jumble of little and big
computers, papers, coffee cups, and stray pieces of
LEGO.

Obvious exits: hallway to E&L Hallway, closet to The
LEGO Closet, and sts to STS Centre Lounge

You see a newspaper, a Warhol print, a Sun SPARCstation
IPC, Projects Chalkboard, and Research Directory here.
```

```
Amy is here.

> say hi
You say, "hi"
Amy says, "Hi Guest!  Welcome!"
```

Users from around the world connect to this virtual place to socialize, talk about their research projects, interact with the virtual world, and create new objects and places. People from the Media Lab are encouraged to build their own offices; users from other places can build their offices as well and connect them via a "virtual Internet." The system developers constructed basic infrastructure and a few interesting and evocative objects and places, but almost all the building was left to the users. This is not a result of time constraints, but is a central principle of the project that will be elaborated throughout this paper.

The first MUD or "Multi-User Dungeon" was developed in 1979 as a multi-player Dungeons and Dragons game. In 1989, a graduate student at Carnegie Mellon University named James Aspnes decided to see what would happen if the monsters and magic swords were removed, and instead each user was allowed to help extend the virtual world. Aspnes' project, which he called "TinyMUD," became less like a game and more like a community. There was no longer a score or goal, but instead a gathering of people who enjoyed one another's virtual company and worked together to extend the virtual world.

At the MIT Media Lab, we decided to see whether this technology which began as a game could be adapted to a more serious purpose: enhancing professional community among media researchers. We chose to build on top of the MOO ("MUD Object Oriented") software developed by Pavel Curtis at Xerox PARC[6]. System development began on October 28th, 1992, and MediaMOO was opened to the public on January 20th, 1993, with an opening celebration called the MediaMOO Inaugural Ball, scheduled to coincide with Bill Clinton's inauguration as President of the United States. As of December 1994, MediaMOO had over 1000 active participants from twenty-nine countries. (See Table 1.) An average of 18 people are connected at the peak hour of the day (4 pm EST); 7 people at the quietest hour (5 am EST). MediaMOO runs on a Sun SPARCstation IPC where it uses 50 Mb of memory. The database is currently 25 Mb on disk. MediaMOO can be accessed from any computer on the Internet at the address mediamoo.media.mit.edu, port 8888. (From UNIX workstations, type: "telnet mediamoo.media.mit.edu 8888"; from computers running VMS, type "telnet mediamoo.media.mit.edu /port=8888".)

Some readers may be surprised that the virtual world of MediaMOO is built entirely in text. With current technology, graphical virtual worlds are awkward at best. For example, no graphical system developed to date can give the user the ability to express more than a minimal range of human emotions. However, the choice of text over graphics for MediaMOO is not based entirely on technical limitations. Text and graphical virtual worlds are different media forms, like radio and television. Television did not replace radio; it changed what radio is used for. Similarly, we believe graphical virtual worlds will change what text-based worlds are used for, but both forms will persist. Text-based worlds are particularly good for writing and foreign language education, giving students a fun and personally meaningful context to use their writing skills. Furthermore, the expressive power of text facilitates rapid creation—in just a moment one can write, "on top of the hill you see a gnarled peach tree." It would take most people much longer to convey the same concept in pictures. Additionally, the written word leaves more to the reader's imagination. For some applications, a text-based world may be preferred for the same

reasons a book is preferred to a movie. Neither books or movies, radio or television, text-based or graphical virtual worlds are inherently "better." They are different media forms, each of which may be better suited to certain applications.

Table 1: An International Community

DOMAIN	NAME	NUMBER OF USERS
edu	Educational (USA)	575
com	Commercial (USA)	182
ca	Canada	50
uk	United Kingdom	48
au	Australia	28
us	Misc (USA)	16
nl	The Netherlands	10
gov	Government (USA)	10
no	Norway	10
org	Nonprofit organization (USA)	10
se	Sweden	9
at	Austria	9
net	Network provider (USA)	9
de	Germany	8
jp	Japan	6
za	South Africa	6
mil	Military (USA)	5
il	Israel	5
nz	New Zealand	3
pl	Poland	3
br	Brazil	3
pt	Portugal	3
bitnet	Bitnet (USA)	3
si	Slovenia	2
ch	Switzerland	2
ie	Ireland	2
be	Belgium	2
it	Italy	2
fi	Finland	2
hu	Hungary	1
kw	Kuwait	1
hk	Hong Kong	1
pe	Peru	1
gr	Greece	1
sg	Singapore	1
fr	France	1

3. A Community of Researchers

While people of a wide variety of ages and backgrounds participate in MUDs, the majority of players on publicly announced Internet MUDs are college students. On MediaMOO, we wanted to attract media researchers. We advertised selectively on

electronic mailing lists devoted to media studies, and required people to submit a description of their research interests to register. Initially, admissions were primarily a self-selection process. With time, word of mouth has spread the address of the system to a broader population, and we have had to enforce admissions requirements more stringently. An elected committee of users advises the MediaMOO administration on admissions decisions.

MediaMOO participants represent a wide variety of disciplines—anthropologists, broadcasters, computer scientists, cultural studies researchers, historians, interface designers, journalists, librarians, linguists, network administrators, psychologists, sociologists of science, teachers, virtual reality researchers, and the like. Particularly strongly represented are writing teachers. A community of writing teachers organized by Tari Fanderclai and Greg Siering meets every Tuesday evening at 8 pm eastern time in "The Tuesday Café" to discuss how computer technology can be used to improve writing instruction. Fifteen to thirty people attend each week. A group organized by Marcus Speh meets regularly to discuss the Global Network Academy, an organization working to use the Internet for education. A group organized by Lee-Ellen Marvin have regular poetry readings.

In most MUDs, characters are anonymous. People who become friends can exchange real names and email addresses, but many choose not to. Conventions about when it is acceptable to talk about "real life" vary between communities. In most MUDs, people begin to talk more about real life when they get to know someone better. However, in some communities such as those based on the "Dragonriders of Pern" series of books by Anne McCaffrey, talking about real life is taboo.

On MediaMOO, we wanted to promote discussions of "real life" and real research interests. Consequently, we initially offered users the opportunity to get an anonymous or identified character, or both. With time, we realized that having identified participants was an important part of establishing a professional atmosphere. Since August 1993, all new members of MediaMOO have been identified with their real names and email addresses. Real names and email addresses are specified on a person's application, and can be changed only by a system administrator or "janitor." (System administrators on most MUDs are called "wizards" or "gods." On MediaMOO, we chose to change the name to "janitor." The janitors are the people who clean up after others. They have the keys to the entire facility, but try not to get in the way of its inhabitants.) While it is possible for someone to lie about their real name, it is not possible for them to lie about their email address, because their initial password is delivered to the address they supply.

Each member also has a description of their research interests. One user of the system, Professor Ken Schweller (aka "cdr"), created a research directory to search through all the member's research interests:

```
> examine directory
Research Directory (aka #1458, Research Directory,
research, directory, and dir)
Owned by cdr.

You see a musty, dusty, leatherbound book. You might try
something like 'find neural net in dir'

Obvious verbs:
  find <anything> in directory
```

```
  g*et/t*ake directory
  d*rop/th*row directory
  gi*ve/ha*nd directory to <anything>

> find "narrative" in directory
Guest consults the Research Directory . . .
Vortex(#116)   --   Programming environments, animal
behavior simulation, sociology of virtual spaces, AI &
Narrative

DougO(#1829)   --   Modeling narrative reality in an
online realtime multiuser environment.

Viridian(#7233)  --  I'm interested in writing and its
many forms (poetry, fiction, etc.), cyclic visual
narratives, and, among other things, dreams.

Gee(#7202)  --  Gee is currently researching multi-user
environments for a possible TV documentary in Australia.
He is interested in how MOO's may impact on visual
artists and how art might be created in virtual space.
Video Art and digital narrative.
```

The research directory facilitates users with common interests meeting one another. It was built soon after MediaMOO's official opening not by the system administrators but by an interested member. Encouraging users to build new things for the system lets them add value to it, and also strengthens their sense of connection to the community.

4. A "Third Place"

In *The Great Good Place*, Ray Oldenburg eloquently argues for the importance of "third places," places which are neither work nor home[7]. The book's subtitle is "Cafés, coffee shops, community centers, beauty parlors, general stores, bars, hangouts and how they get you through the day." Oldenburg summarizes:

> Third places exist on neutral ground and serve to level their guests to a condition of social equality. Within these places, conversation is the primary activity and the major vehicle for the display and appreciation of human personality and individuality. Third places are taken for granted and most have a low profile. Since the formal institutions of society make stronger claims on the individual, third places are normally open during the off hours, as well as other times. The character of a third place is determined most of all by its regular clientele and is marked by a playful mood, which contrasts with people's more serious involvement in other spheres. Though a radically different kind of setting from the home, the third place is remarkably similar to a good home in the psychological comfort and support that it extends. [Oldenburg 89, p. 42]

The population of third places are self-selected—people go to a café because they choose to and not because they must. From this self-selection process emerges a group of people with some degree of common interests and values. Traditional third places draw people from the local geographic area. On the Internet, MUDs become third places which draw people with common interests from all around the world. People from the opposite

hemisphere can become a part of your daily life. On MediaMOO, those people also share research interests. MediaMOO can be described as an endless conference reception. The conversation fluidly moves between personal and research issues.

As Oldenburg points out, conversation is the primary activity in third places, and MediaMOO is no exception. Most of those who chose to respond to an email survey of randomly selected MediaMOO users stated that they had had interesting conversations and met new people in their field through MediaMOO. Paul Dourish of Xerox EuroPARC writes:

> I've met a number of people whom I've talked to about my research and theirs, although I think there are fewer (probably just the one or two) whom I've actually talked to enough to refer to as "new professional contacts."
>
> One I met while he was a Guest; we started talking after he read my research description. The other I met early on when I was stumbling around asking all sorts of people for help on doing things just after I got my character.

The process of helping new players, often called "newbies," is an important part of MUD culture. For Paul, the process of being new and reaching out for help has led to his most meaningful professional contacts— once while he himself was new, and once while he was helping another new player. The context of the MUD in these instances provided a shared context and shared activity which promoted social interaction.

A number of users commented that their most meaningful interactions on the MUD were with the "regulars"—the people who use MediaMOO the most and are most likely to be logged on at any given time. Oldenburg emphasizes the importance of "the regulars" to a third place—they give a place its character.

Some question the value of the sort of interaction which takes place on MediaMOO. One user wrote that "frankly it strikes me for now as a schmooze place for people with nothing better to do, not a place where more productive things will happen than already happen in other communicative modes." It's worth noting that to determine whether an activity is "productive" requires a definition of what it means to be "productive," and this quickly leads to questions of a philosophical nature. MediaMOO challenges the boundaries between work and play, forcing one to rethink what counts as productive. Most veteran conference-goers attest to the fact that the conversation at coffee breaks and receptions is usually more valuable than the sessions attended. We believe that the exchange of ideas and networking which take place on MediaMOO are similarly productive. Serious exchange of ideas often takes place because of, not in spite of, more informal social interaction.

5. Constructionism

In an important sense, MediaMOO is more like a community center than a tavern or conference reception, because it serves as a context for member-organized events and projects. The center itself—its rooms and objects—are constantly being constructed and reconstructed by the participants. This is an example of the application of *constructionist* ideas to virtual reality design.

The term "constructionism," first coined by Seymour Papert[2], involves 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. (This idea is based on the theories of Jean Piaget.) To this, constructionism adds the idea that people construct new

knowledge with particular effectiveness when they are engaged in constructing personally-meaningful products. They might be constructing sand castles, LEGO machines, computer programs, or virtual objects. What's important is that they are actively engaged in creating something that is meaningful to themselves and to others around them.

This philosophy is central to the design of MediaMOO. The goal of MediaMOO's initial design was to create not a complete virtual world for users to enjoy, but the barest skeleton to inspire users to construct personally meaningful objects and places. The next three sections will discuss users constructing places in the virtual world, taking an initial step towards programming through "contributory objects," and programming new objects and places.

6. A World Built by Its Inhabitants

The center of MediaMOO is a virtual copy of the MIT Media Lab. There is a psychological power in the ability to construct a representation of a real place in the virtual world which is your own. The challenge was: how do we let people build offices in California and Australia without trying to build everything in between? We developed a "virtual Internet" as a technique for spatial ellipsis. Users from other places can build their own offices by connecting them via the virtual Internet. You step inside a computer and dematerialize into a collection of packets, and can then travel through a tree-like structure, going down to root and back up through the hierarchy (actually a much more orderly arrangement than the real Internet!) Each user can add his or her own Internet site, if it is not already there.

Daniel (Daniel Rose) writes of his first experience on MediaMOO:

> I logged in first as a Guest, and came out in the E&L Garden. I had never been to the Media Lab IRL [in real life], so I felt a bit lost.... Then I met Michele, and when she found out I was from Apple, she said that someone had constructed our building, and she'd take me there.... When we stepped out into the Apple R&D building atrium, I felt this incredible shock of recognition... More than that, I felt a sense of relief that there were places here that were familiar and home to me just as the Media Lab was to you. And all of this was from a couple of lines of textual description.

The actual text a user sees when they arrive at apple.com in the virtual Internet and step out looks like this:

```
apple.com
You are in a maze of twisty little passages.
You see the back of a computer screen here.
Obvious exits: down to com and out to Apple Computer R&D
Atrium

> out
Your packets gather in a glob, and then flow into the
screen!  You feel yourself rematerializing.

Apple Computer R&D Atrium
You are in a glass atrium, four stories tall. Offices
look out from the walls.  Beyond the glass wall to the
east, there is some arcane construction taking place.  A
walkway exits the atrium to the west.
```

To most people, this is a rather unremarkable description. The idea of rematerializing might appeal to *Star Trek* fans, but the room description itself is bland—it sounds like an office. However, to Daniel this provoked a "shock of recognition" and a sense of belonging. Representations of the real give users a sense of comfort and make the medium more appropriable: if your office is there, then you belong there.

The geography of MediaMOO has no real unity. A visitor once called it "a multicultural mess." We consider this to be a high compliment. Each person's virtual "home" is an expression of their personality. For example, consider the virtual homes of members of the MediaMOO elected Membership Advisory Committee at the time of this writing: Michael Day, a writing teacher, lives in "the panopticon." Randy Farmer, a researcher in virtual communities, lives in his company headquarters, "Electric Communities." Beth Kolko, a professor of cultural studies and rhetoric, lives in "in media res." Diane Maluso, a psychology professor, lives in "Quiet Light." The public areas of MediaMOO are neatly organized; however, they are a minimal part of the virtual world. The private areas are not coherent with one another, but express the rich diversity of the population.

7. Contributory Objects

Objects in the virtual world serve many of the same functions as places; building amusing and/or useful MUD objects is a means of creative expression for the designer, and completed objects promote social interaction for the community. One design paradigm which has proved particularly successful is the idea of a contributory object. For example, in the dressing rooms of the MediaMOO Ballroom, it is possible to design new costumes for the clothing racks:

```
> northwest
You step through the velvet curtain into the women's
dressing room.

Women's Dressing Room
The dressing room is a clutter of gowns, hats, and
gloves from all different eras.  Type 'examine rack' for
more information.

Obvious exits: east to Ballroom Foyer and south to The
Ballroom
You see women's clothing rack and a gold plaque here.

> list rack
Outfits on the rack:
[Space permits us to show only a few of the 89 costumes
currently on the rack.]
1: a classic black cocktail dress and snakeskin pumps by
Amy (#75)
7: a halter wrap dress, cut to mid-thigh, colored in
pastels with a distinctly tie-died look to them by Lenny
(#115)
```

```
14: black leather one-piece jumpsuit with glistening
alloy lapels by Guest (#113)
21: a shimmering jester's costume, in mauve and
lavender, with a headdress of orchids and dove-feathers,
and turquoise pendant earrings, set off by turquoise
high-heels by Mauve_Guest (#702)
58: An elegant white lace stretch blouse with tailored
red hunting jacket and black stretch pants. Tally ho! by
rowena (#8642)

> wear 1 from rack
You slip into a classic black cocktail dress and
snakeskin pumps.
```

At the MediaMOO Inaugural Ball, people spent as much time in the dressing rooms as in the ballroom itself. The costumes on the rack are effective conversational props. More important, however, is the fact that it is easy to contribute a new costume to the rack. One can simply type "design Convergence T-Shirt and mirrorshades for rack" and it is added to the collection of available costumes with the designer's name attached. Contributory objects offer a lower threshold to participation than actually programming a new object. The user has a sense of having taken a first step towards mastering the computational environment, and a sense of having contributed something to the community.

Another example of a contributory object is Lucy, the ballroom's bartender. It is possible to teach the bartender what to say when a drink is served. An anonymous guest with a philosophical bent taught Lucy how to serve a "metaphysical Pepsi":

```
> order metaphysical Pepsi from Lucy
Lucy says, "One Metaphysical Pepsi, coming your way...or
possibly it's heading in the opposite of your direction,
but still coming toward you through a time-space
continuum."
Lucy says, "I'll have that for you in just a minute."

> say thanks
You say, "thanks"

Lucy pours your Metaphysical Pepsi.  Or maybe she
doesn't.  Maybe Lucy is just a product of your
imagination.  Maybe everything is just a product of your
imagination.  Your senses tell you what is going on
around you, but why should you trust your senses?  Just
because they've always been there does not by any means
prove their reliability.  Go ahead and 'drink' your
Pepsi, but next time maybe you'll give a little thought
to the fact that you may not actually be drinking
anything...in fact, you may not everbe standing here.
Lucy hands you your Metaphysical Pepsi. "Here ya go."
```

```
> look at Pepsi
It's a Pepsi...or is it?  How can you really be sure?
Of course, your senses tell you it is a Pepsi, but who's
to say your senses are not controlled by some external
factor?

> drink Pepsi
You drink your Metaphysical Pepsi.
```

Ordering a metaphysical Pepsi can turn the conversation in a rather philosophical direction. However, even if the bartender is just serving a more mundane sort of beverage, it helps to create a context for social interaction. There are a variety of contributory objects around MediaMOO, including statues of famous sociologists and historians of science that you scribble on (designed to promote discussion of their work), and a projects chalkboard for ideas for new objects and places. Some have more "serious" purposes than others—but even the most playful serves a useful function: facilitating social interaction. Just like in real life, conversations often make an elegant transition from casual small talk to a serious exchange of professional ideas.

It is interesting to note that attributing the contribution to a person is an essential feature—it allows the person to take pride in what they have done, and discourages virtual vandalism. Even though guests are effectively anonymous, there have been few inappropriate contributions to the costume racks. However, at one point it was possible to add messages to the bartenders without any attribution. One might add something like "Lucy starts polishing glasses behind the bar" to the bartender's program. Unfortunately, people added messages that were trivial or obscene and even deleted other people's contributions since the program allowed it. The software was rewritten to provide attributions for messages added like the other contributory objects around MediaMOO.

8. Programmed Objects

Contributory objects are just a first step; they facilitate users learning to build and program new objects in the virtual world. Another easy step into greater involvement with the computational world is the use of oboject-oriented programming (OOP). The virtual world is made up computational "objects," each of which has its own characteristic properties. When a "child" object inherits from a "parent" object, the child acquires the characteristics of the parent. For example, it is possible to create an object that moves around simply by creating something which inherits from "generic portable room." The child object can then be customized and new programs added to extend it. The generic portable room has been used to create a diverse collection of objects:

```
> @kids #445
generic portable room(#445) has 124 kids.
Yellow Cab(#296)
Generic Neo-Scrabble Board(#1439)
MediaMOO TV Helicopter(#1659)
The Bob Marley Community Media Bus(#3655)
Generic Train(#4559)
Sound Proof Room(#3136)
an emacs window(#4607)
'77 Jeep Cherokee(#5731)
```

```
goldfish bowl(#4761)
portable hole(#6165)
The Autonomous Drone(#7815)
StarkNet School Bus(#7930)
Box of Delights(#8233)
Bible Study Room(#4014)
Generic Cards Room(#8757)
Jack's Laboratory(#3401)
dictionary(#6303)
water(#9225)
tiny envelope(#9566)
An Igloo(#8999)
an aluminum mailbox(#5449)
[etc.]
```

These projects range in complexity from simple customization of the generic portable room to substantial projects using the generic as their starting point. For example, a user named Moose (Tom Meyer) used generic portable room as the first element of his train system. The train system gives new users a tour of interesting places in the virtual world. The object-oriented environment makes it easy to create something satisfying, and later refine it.

The combination of the ability to construct things and a community context for that construction is particularly powerful. In an informal ethnographic study[8] of twelve adults who learned to program for the first time on a MUD (eight on MediaMOO; four on other MUDs), we found that the community provides:

- motivation for learning,
- emotional support to overcome technophobia,
- technical support, and
- an appreciative audience for work completed.

Regardless of whether users already have technical experience, the ability to extend the virtual world with new objects and places provides:

- an opportunity for creative self-expression,
- a means to establish a personal identity within the community,
- a way for individuals to contribute something to the community,
- a context for social interaction (both in the process of creating the objects, and in their use when finished), and
- an enhanced sense of connection to the community.

9. Future Directions: A MUD for Kids

The MediaMOO Project was conceived in part as preparation for a MUD for kids, "MOOSE Crossing," which is currently under development. We believe that this technology can provide an authentic context for children to learn reading, writing and programming. In these virtual worlds, writing and programming become means of self-expression to a community of peers. MUDs are a constructionist playground.

Developing good MUD objects is as much creative writing as programming. One hypothesis of this research is that divisions between the humanities and the sciences are often too sharply drawn and counter-productive, and a more integrative approach has advantages for many children. A second hypothesis is that the social and contextual nature

of these worlds may help young girls to be more comfortable with computers and programming.

If kids are really to make good use of MUDs, however, it will be necessary to improve the programming language and the interface. We are currently developing a new programming language called MOOSE designed to make it easier for children to program new objects. ("MOOSE" stands for "MOO Scripting Environment." The MOOSE language is built on top of Pavel Curtis' MOO software.) We are also developing a multiple-window client program called MacMOOSE which we hope will make the system more usable. We hope to apply lessons learned in the development and use of the Logo language to make a MUD language more accessible to kids.

At the conclusion of *Mindstorms*, Seymour Papert describes his vision of a technological samba school. In samba schools in Brazil, members of a community gather to prepare a performance for Carnival. Everyone is learning and teaching—even the leads need to learn their parts. People of all ages learn and play together as a community. Papert believes that computers can create a kind of technological samba school, and we believe MUDs may begin to realize that vision.

10. Conclusion: Constructionism and Virtual Reality

Many current virtual reality projects, particularly those intended for entertainment, are like Disneyland: artists and programmers design wondrous creations for users to experience. If this technology is "interactive," it is in the limited sense that most hypertext systems are interactive: there are multiple paths through the material, and the system has a limited ability to react to the user. However, the ways in which the system reacts are designed by the artists and engineers who constructed it and not by the users.

Virtual reality applications in the fields of scientific visualization and training simulation often promote more meaningful user interaction, but are typically not situated within a virtual community. The chemist's walk-through molecular model would be more useful if placed in his or her virtual office, where colleagues could come to visit. Current research in text-based virtual communities points to the importance of developing tools to allow the chemist to build his or her own virtual office. The chemist could fill the office with objects that are both useful and an expression of personal taste, some personally designed and some designed by others, just like a real office.

If the power of this technology is to be unleashed, users need to be the creators and not merely consumers of virtual worlds. We believe that constructionist principles are of central importance to the design of virtual reality systems. MediaMOO is an exploration of this idea.

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