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OPINION

Why Digital Avatars Make the Best Teachers

By JEREMY BAILENSON

My virtual representation of me, commonly known as an avatar, can outperform me as a teacher any day. It can pay unwavering attention to every student in a class of 100 or more; show my most spectacular actions while concealing any lapse, like losing my cool; and detect the slightest movement, hint of confusion, and improvement in performance of each student simultaneously.

Most people may think of avatars as too primitive to show such details. But at Stanford University's Virtual Human Interaction Lab (http://vhil.stanford.edu), my colleagues and I use cutting-edge technology. We could build an avatar that looked just like you (the heads we produce look real enough that they are used in police lineups), gestured like you, even touched like you, thanks to haptic devices that relay the speed and force of hand movements. And the technology can be transmitted over a network.

The prevailing wisdom in teaching, as in just about every form of social interaction, is that face-to-face contact is the gold standard, trumping all forms of mediated interactions. But as virtual reality moves from games into rigorous scientific applications, it is inevitable that we will rethink the importance of physical location. We know that gasoline is expensive and travel can be a nuisance. But more important, a teacher's avatar has powers that just don't exist in physical space.

Virtual reality functions in cycles — the computer figures out what someone is doing, then redraws his or her avatar to show changes based on that behavior.

For example, as a student in Chicago moves his head, looks toward the teacher, and raises his hand, sensing technology measures those actions. As the student moves, the computer of the teacher in New York, which already has an avatar with the student's facial features and body shape, receives that information over the Internet and modifies the avatar to make it move, too. Tracking the actions of teacher and students, transmitting them online, and applying them to the respective avatars all occur seamlessly, and all the participants feel as if they are in the same virtual room, in a movie together.

No participant needs to try to behave in a particular way, either. In a video game, a person must act intentionally to produce behavior. But in virtual reality, tracking equipment, like magnetic sensors and video cameras, detects what a person does and instructs the computer to redraw the avatar performing the same action. Everyone's computer sends the other machines a stream of information summarizing the user's current state.

However, users can alter their streams in real time for strategic purposes. For example, a teacher can choose to have his computer never display an angry expression, but always to replace it with a calm face. Or he can screen out distracting student behaviors, like talking on cellphones.

Research by Benjamin S. Bloom in the 1980s and subsequent studies have demonstrated that students who receive one-on-one instruction learn at least an order of magnitude better than do students in traditional classrooms.

Virtual reality makes it possible for one teacher to give one-on-one instruction to many students at the same time.

The use of the Web to tailor messages to different recipients has received ample discussion, most notably in the arena of advertising; we all know about spam messages that appear to be from one of our colleagues. In a virtual classroom, the teacher can tailor not simply a message, but her identity.

Of course we must be careful not to cross the line between strategic transformations and outright deception. Probably none of us would want to see politicians, a few years in the future, take advantage of new technology to tailor electronic messages by combining their faces with an undetectable share of those of the recipients — knowing that including the citizen's face can sway his vote. But good teachers already use psychology to help students learn, and standard techniques can be made more effective in virtual education.

Students in a given classroom, like most large groups of people, include a wide range of personality types — for example, introverts and extroverts. Some students might prefer communication accompanied by nonverbal cues, like gestures and smiles; others may prefer a less-expressive speaker. A number of psychological studies have demonstrated what is called the "chameleon effect": When one person nonverbally mimics another, displaying similar posture and gestures, he maximizes his social influence. Mimickers are seen as more likable and more persuasive than nonmimickers.

In a number of laboratory studies of behaviors including head movements and handshakes in virtual reality, my colleagues and I have demonstrated that if a teacher practices virtual nonverbal mimicry — that is, if she receives the students' nonverbal actions and then transforms her nonverbal behavior to resemble the students' motions — there are three results.

First, the students rarely are conscious of the mimicry.

Second, they nonetheless pay more attention to the teacher: They direct their gaze more at mimicking teachers than they do at teachers who are behaving more normally.

Third, students are influenced more by mimicking teachers — more likely to follow their instructions and to agree with what they say in a lesson.

When I teach a class of 100 students face to face, I try to match my nonverbal behavior to that of a single student, and I am forced to devote ample cognitive resources to that effort. But in a virtual classroom, my avatar can seamlessly and automatically create 100 different versions, which simultaneously mimic each student. Without my having to pay any attention to my actions, let alone to type commands on a keyboard, my computer changes my gestures and other behaviors to imitate each student's gestures and behavior. In effect, I can psychologically reduce the size of the class.

The virtual classroom, too, can be tailored for each student. Rooms have a sweet spot — the location varies from room to room but is often front and center, a few meters away from the teacher. Other experiments, in my lab and at the Research Center for Virtual Environments and Behavior at the University of California at Santa Barbara, have shown that students randomly assigned to sweet spots in real-world classrooms do about 10 points better on exams than do students sitting elsewhere in the rooms.

Of course, in the physical world, only one student can sit in the sweet spot. But because virtual rooms are drawn separately for each user, every single student's avatar can be sitting in the sweet spot — and will see classmates' avatars sitting in other locations. In a series of studies, we demonstrated that putting multiple students simultaneously in the virtual sweet spot substantially increased the learning of the group.

Another advantage of the virtual classroom is that a teacher can use data collected by the computer to improve students' learning as well as his or her own performance. Given that decades of research have pointed to the importance of eye contact during speaking, my colleagues and I created an algorithm that showed teachers exactly how much eye contact they gave each student in a large virtual classroom. If the teacher was not looking at a student's avatar, it would slowly become translucent until the teacher looked at the student again, when the avatar would once more become opaque to the teacher. With that algorithm, teachers looked much more evenly around the classroom. Virtual technology can guarantee that no child gets left behind.

In dozens of experimental paradigms, we have demonstrated similar advantages of virtual classrooms. The advantages are most effective in classes with large student-to-teacher ratios, where they are needed most. Although the actual classrooms of Ivy League universities may never lose their prestige, the practical implications are clear: The digital transformations of virtual classrooms can increase students' learning.

Jeremy Bailenson is an assistant professor of communication at Stanford University.

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