Using Virtual Identities in Computer Science Learning for Broadening Participation

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Project Goals and Description: We hold workshops in Boston and Cambridge public schools providing opportunities for middle and high school students to:

- learn computer science in ways relevant to students' own communities and interests,
- develop self-images as computer scientists.

As a research goal, these workshops provide us a research opportunity to discover best practices for using virtual identities (avatars, characters, social media profiles, etc.) to enhance student performance, engagement, and learning for diverse public school learners of computer science. Our workshops involve eliciting student-generated themes, questions, challenges, and goals. Toward this end, we have also developed our own custom platform called *MazeStar*, used in the workshops, that allows students to explore their own ideas by creating their own games while learning about human-computer interaction, interface design, privacy, coding, problem-solving, and more.

Figure 1. Students at workshop at a local area Boston high school.

It is important to us to bring students' diverse cultures into the fabric of computing. A core component of *MazeStar* is our game for learning programming called Mazzy (see Figure 2) in which play requires learning building blocks of coding.

Figure 2. The computer science learning game Mazzy, in our MazeStar platform.

We approach STEM education and access to high quality, relevant learning opportunities as a social justice issue of our time, this includes seeing diverse students' identities as resources, rather than deficits, for STEM learning. Hence, we start with student identified relevant themes, questions, challenges, and goals and see who students are and what they bring to the table as assets, important and rich resources to draw on. We utilize aspects of the nationally recognized Exploring Computer Science (ECS) curriculum to spark student excitement about computing and focus on bringing the culture into the fabric of computing.

Outcomes: Using qualitative, quantitative, and AI/machine learning analysis techniques, we have already formulated a few best practices and guidelines when it comes to avatar use in education. We have also systematically explored the impacts of different avatar types on users, beginning with distinctions between anthropomorphic vs. non-anthropomorphic avatars, user likeness vs. non-likeness avatars, and other conditions informed by insights from the learning sciences and sociology in crowd-sourced studies with over 10,000 participants. A related paper with my EECS Ph.D. advisee Dominic Kao will receive the Emerging Virtual Scholar Award at the American Education Research Association (AERA) conference, the largest conference in the learning sciences. In Dec. 2016, I was invited to speak at the White House Office of Science and Technology Policy on virtual reality for broadening participation.

Taken together, our studies have revealed that avatars can support, or harm, student performance and engagement. A few notable trends are: 1) 'role model' avatars (in particular scientist avatars) are positively effective, 2) 'likeness' avatars (avatars in a user's likeness) are *not* always positively effective, 3) simple 'abstract' avatars (such as geometric shapes) are *especially positively* effective when the player is undergoing failure, e.g., 'debugging,' and 4) *'successful likeness'* avatars that look like the user when doing well and appear 'abstract' otherwise are *very positively effective*. We have studied other topics such as the role of thematic content (e.g., STEM-related vs. fantasy), graphical embellishment, interface style, and more in computer science learning.

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