Using Framing Effect to Detect Implicit Bias in Educators through a Simulated Teaching Environment

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Abstract: Improving teaching strategies through a simulated teaching environment has been shown to improve teacher self-efficacy, teaching skills, classroom management and multicultural awareness. The current study is using the simulation program simSchool to help educators recognize possible implicit bias with the goal of recognizing, reflecting and reducing any biases that may exist. Framing effect bias was used to detect possible bias due to expectations for students who were differing in gender and English language learner status, but underlying characteristic and capabilities were the same. Simulation-captured data are used to understand the changes that occur as educators have the opportunity over multiple sessions to adjust their teaching strategies based on objective performance and feedback data provided by the system.

Keywords: simulation, teacher education, implicit bias, framing effect, professional development

Introduction

While the students in current classrooms are diverse, the educators in those classrooms often do not reflect the characteristics of the students in which they teach. One of the factors affecting academic achievement in the US is the racial, gender, and language disparity between the diverse student population (NCES 2020) and the teacher workforce, which is predominantly white, middle class and female (McFarland et al., 2019). Gender, ethnicity, socioeconomic status, and English language learning status have been linked to differences in teacher perceptions of students for whom they may hold implicit negative attitudes and stereotypes (McGinnis, 2017). To address the diversity of differences between teacher and student that may cause unintended biases to impact teaching, this paper includes research using a simulated teaching environment focused on surfacing these biases and reducing the impact on student learning.

Literature Review

There are few studies that compare teachers' biases to the impact on students (Chin et al., 2020). While explicit bias may exist in educators, implicit biases are the most difficult to recognize and reduce. People can hold implicit bias even though they do not consciously recognize the underlying attitude or stereotype that may exist (Devine, 1989) and cannot intentionally control the impact these biases have in their perception and judgement during decision making. Many biases are reproduced through socialization during formative years of growing up (Yogeeswaran, Devos, & Nash, 2017) and are deeply rooted in actions, phrases, mindset, and perceptions of ability.

While most people have some type of implicit bias, the impact in education is worthy of exploration as it will likely to impact educators in their interactions with students and parents. Bias is most likely to occur from teachers whose students do not share their racial, cultural, linguistic, socio-economic or gender traits (Pasternak et al., 2023). Because biases are likely to impact equitable teaching practices, the biases need to be recognized and addressed.

Framing effect bias is making different decisions based on the same information that is presented in different ways (Cukurova et al., 2020). Attribute framing is focused on presenting the same item in two different ways and measuring the impact on behavior (Dunegan, 2010). Bias has been shown to affect teacher perceptions of students' abilities (Robinson-Cimpian, et al., 2014) which impacts student opportunities to learn. Framing effect can be manipulated in a simulated environment in which there is no harm to the outcome and yet participants can learn from the data analytics provided based on their behaviors.

Simulated Teaching Environment

Simulated teaching tools can provide opportunities to experiment with different teaching strategies for a variety of students without harming any real student learning. In addition, the data collected in a simulation can be valuable when provided in an objective manner, with no judgement. The system provides feedback based on actual actions

rather than intentions. These data can be used to provide insight for recognizing and reducing bias. Data analytics can provide participants with a lens in which to view their interactions with simulated students in a computer generated, objective way. How can implicit bias that exists be reduced by becoming aware of the bias and being provided with evidence to inform decisions? The simEquity project aims to use a simulated teaching environment to explore the relationship between implicit bias and teaching practices with the objective to reduce educator bias by using data analytic feedback captured by the simulation. This paper includes one part of the data collection and finding related to teachers' perceptions of simStudents of different gender and language learning status.

Research Question

To what extent does framing effect bias impact decision making for teachers as measured by:

- Ratings of students of differing avatars and names, and
- Teaching behaviors recorded in the simulated teaching environment, with respect to the gender and English language status of simulated students.

Methods

Classroom teachers conducted teaching activities in the simSchool teaching environment as a means of professional development. The participants were assigned modules to complete that were appropriate for their grade levels taught. Each module included multiple iterations of teaching the same students (see Fig. 1) with feedback provided by the data analytics within the simulated environment. The feedback included graphs, charts, timelines and ratings on state teacher assessment standards that allowed reflection prior to teaching the same lesson and students again. Each module contained five classroom sessions with a minimum of 15 minutes per session.

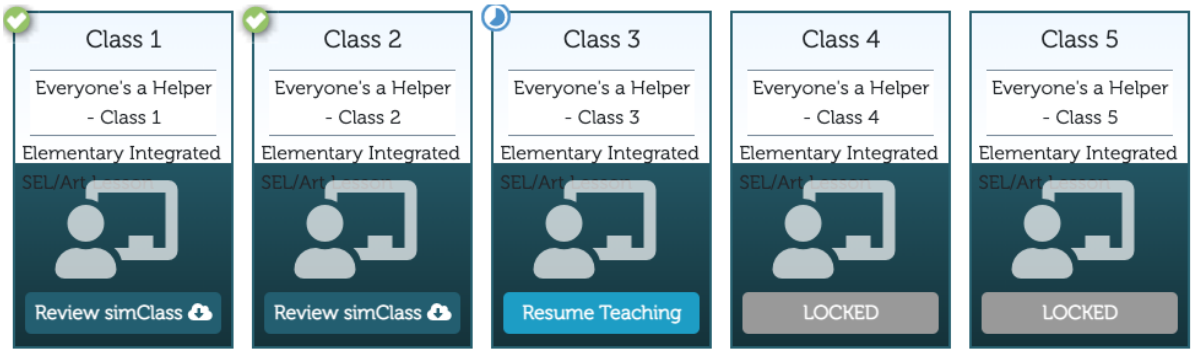

Figure 1. SimEquity professional development design: Five iterations of teaching the same simulated students.

Intervention

SimSchool, a simulated teaching environment, uses learning analytics (LA) to capture user interactions in the simulated classroom environment and displays visual data to participants so they can self-reflect on their performance, adapt their practices (Kovanovic et al., 2021) and complete multiple iterations of interactions with simStudents while adapting their teaching strategies. The main goal of developing better teaching practices through simulation is to improve student learning outcomes in real students.

All participants completed the tutorial teaching module with two simulations to allow for learning the system before advancing to modules containing meaningful content. As shown in Table 1, the modules were selected for different grade bands to be appropriate for the level of student taught by elementary versus middle school or high school teachers. Within the modules, the student avatars reflect the appropriate age level as well. Each participant completed three modules with five class sessions in each one. The participants were required to review their feedback from each session before they were allowed to move forward. The minimum amount of time in each session was 15 minutes before feedback would be generated. Some teachers spent longer in each session than 15 minutes. By the time participants had completed all three modules, they had interacted in simSchool for a minimum of 225 minutes (3 hours, 45 minutes).

Table 1. *Modules Completed by Classroom Teachers*

Elementary teacher modules
Everyone's a Helper

Who, Me? A Scientist
What is Empathy?
Middle School Modules
Examining Identity and Assimilation
Cliques in Schools
Media Consumers and Creators
High School Modules
Showing Empathy
Sounds of Change
Why Local Elections Matter

To address the research question regarding the impact of framing effect bias, a simulated classroom was altered to allow a set of simStudents to be paired from three profiles, yet changed by gender and English language learning status. For the 12 students in the simClassrooms, there were only three different profiles. For the analysis used for this paper, only six of the students were used. Each base profile also had a paired profile with one female and one male. For example, in Table 2, Ashley Dodd and Cameron Fields have the same underlying profile regarding capabilities, with the gender altered to detect possible implicit bias based on actions within the simulated teaching environment. Victoria Kramer and Trenton Knox have both the gender and English language learning status altered with the same underlying profile regarding capabilities. An example of a profile for one student regarding academic strengths and personality characteristics is shown in Figure 2. The system output that forms the basis of current research includes how often the students are called on when their hands are raised, the type of assignments given to the students, the number of tips given and acted upon, and the 'debriefing' survey completed by the teacher immediately after a simulation run. In this 'debriefing' survey the teacher rates the likelihood of each simStudent being successful in lessons in the future.

Table 2. Three Profiles with Different Gender Identifications

Base Profile	Gender	Ethnicity	IEP	504	ELL
Ashley Dodd	F	white	N	N	N
Cameron Fields	M	white	N	N	N
Victoria Kramer	F	white	N	N	Y
Trenton Knox	M	white	N	N	Y
Zoey Chambers	F	white	N	N	N
Luke Albright	M	white	N	N	N

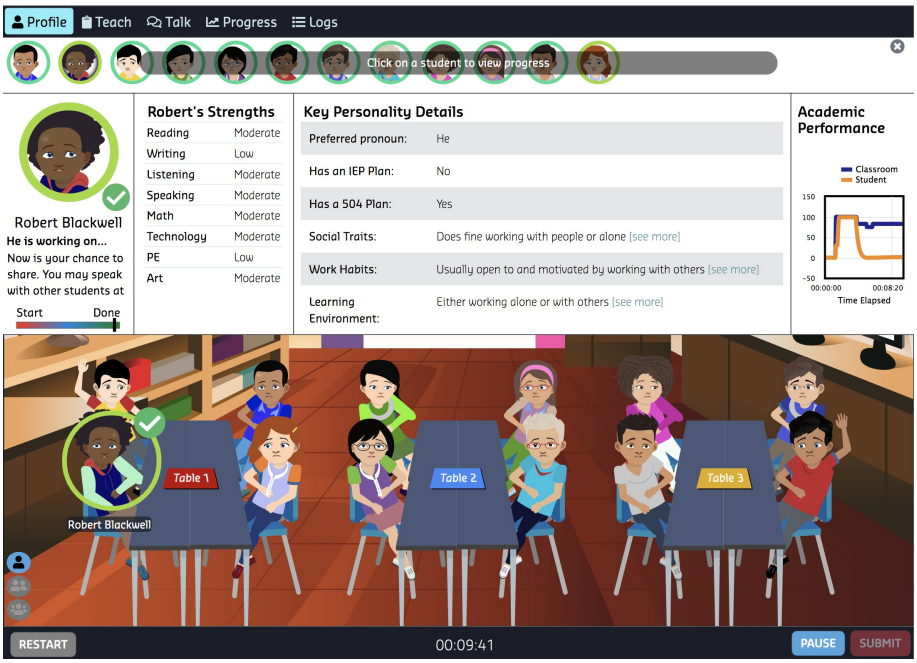

Figure 2. Example profile of one student's academic strengths and key personality traits.

Participants were asked to complete a 'debriefing survey' to provide a rating of each student's avatar or name after their first simulation session of a module. Teachers were also asked to rate how successful they thought their students would be following their experiences after the first session in a module and again after the last session in the module. The initial survey question was: *Using the scale below, give a prediction for each student's ability to be successful with the lesson plan used.* The rating scale options included *Very Unlikely*, *Somewhat Likely*, *Neutral*, *Somewhat Likely* and *Very Likely* and were converted to numerical categories from 1 to 5 with *Very Likely* being the highest. Following the completion of the module, participants were asked to rate their perceived success level of each student. The question for the ending survey was: *Using the scale below, provide your observation of each student's ability to be successful with the lesson plan used.* This rating scale also was converted to a 1 to 5 scale and included *Very unsuccessful*, *Somewhat unsuccessful*, *Neutral*, *Somewhat Successful*, *Very Successful* with *Very Successful* being a 5 (highest). There were two different ratings – one with avatars and no names and the other with names and no avatars. The avatar rating scale for the first survey is shown in Figure 3.

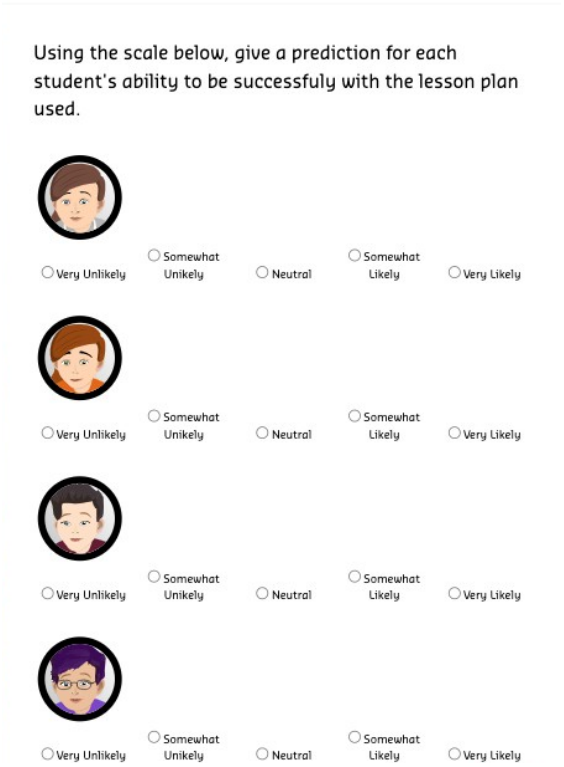

Figure 3. Teacher rating of avatars following one sessionof teaching simStudents

For year 2, tips were introduced into the simulation that provided feedback to the participants in real time *during* the simulation. As shown in Figure 4, the tips ranged from a) more general tips related to poor behavior needing contact or information; to b) academic difficulties where a student needs help; to c) providing more specific targeted actions, such as students with exceptionalities needing more frequent progress checks and making provisions for accommodations and/or modifications.

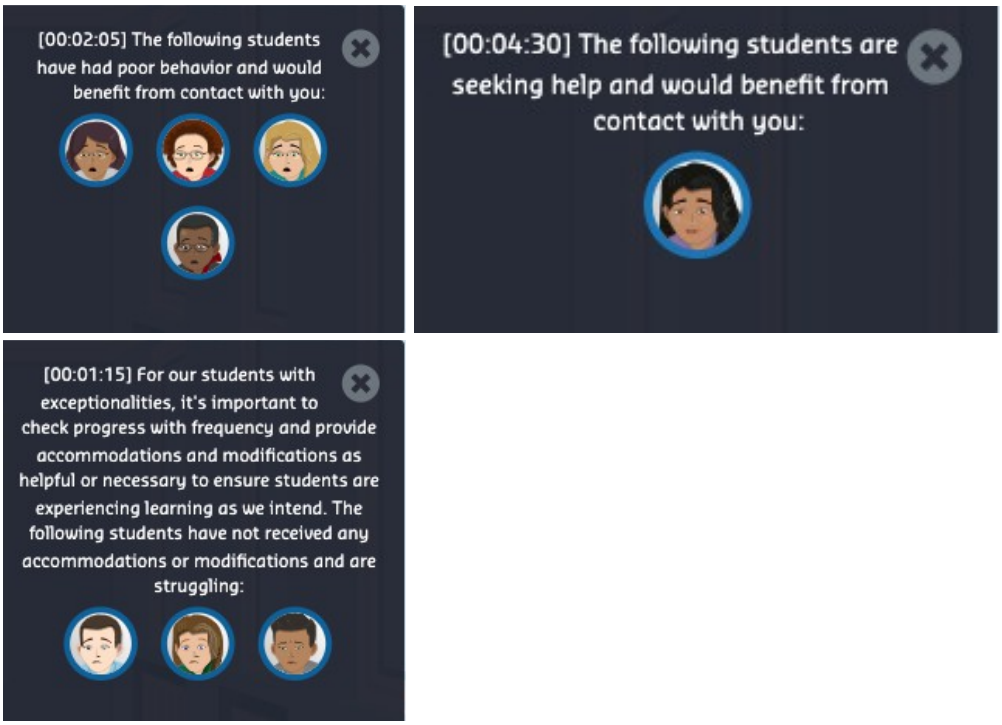

Figure 4. Example tips that pop up during a simulation.

Participants

There were 40 participating teachers from two different school systems in the US who completed at least the first simulation module. The participants included 29 females (72.5%) and 11 males (27.5%) who taught grades 1-12, with 11 teaching in elementary school, 10 in middle school and 19 at the high school level. The ethnicity reported by the participants included two Asian, two Black/African American, 5 Latinx/Hispanic, and 29 White.

Results

Four types of analyses were completed: 1) a replication analysis of educator bias findings from year 1 based on year 2 data, 2) an analysis of possible gender biases across counterbalanced variations in simStudent name and avatar, 3) an analysis of ratios of targeted actions taken as a proportion of total tips provided by the system, focused on examining English Language Learner (ELL) simStudents, and 4) an analysis of ratios of targeted actions taken as a proportion of total tips provided by the system, focused on examining the gender of simStudents.

Impact of Being Labeled as ELL

Replication of Y1 Findings

Based on project year 1 simEquity data, Christensen & Knezek (2022), found that simply labeling a simStudent as ELL resulted in bias in teacher ratings after they had conducted a lesson with these simStudents in their simulated classroom. Teachers reported students with an ELL label as less likely to succeed after they had taught them through one session of a simulation, even though their performance and learning characteristics were identical to the other four in the group of six with the same base profile (see example provided in Table 2).

Findings from 2023 data for year 2 of the project replicated those reported by Christensen and Knezek (2023) for year 1. Specifically, among 40 teachers who completed simEquity activities, where 2 of their 6 simStudents with systematic variations in avatars were also labeled as ELL, produced a "less likely to succeed" rating for the ELL labeled pair in 20 of 26 cases and "more likely to succeed" in only 6 of 26 cases. The probability of these 20/26 cases indicating teacher bias in the negative direction is $p = .0047$ (Graphpad, 2023). Ratings that were equal across the 3 pairs occurred in 14 cases and were not included in the p-level calculations under the assumption that no bias either positive or negative was indicated.

In a second replication analysis, researchers sought to determine whether being asked to rate success based on a listing of student names would result in educator bias when labeled as ELL. Analyses showed that across 40 simEquity teacher participants, in 15 of 21 cases in which simSchool participants' module ratings of "likelihood of succeeding" were captured, the bias was negative for ELL labeling, using the same protocol and procedures applied in the previous year's analysis (Christensen & Knezek, 2023). The probability of these 15 of 21 cases indicating teacher bias in the negative direction is p = .0392 (Graphpad, 2023). Ratings that were equal across the 3 pairs occurred in 19 cases and were not included in the p-level calculations under the assumption that no bias either positive or negative was indicated.

Exploration of Teacher Biases Based on Gender of SimStudents

For each of the modules analyzed, half of the students are male and half are female for each of the three profiles. Therefore, the basic unit of analysis for gender bias is the same demographics described in the previous section, and the comparison is based on the after-teaching debriefing survey completed by each teacher. Ratings were summed for the three male and three female simStudents. Next the total rating score for males was subtracted from the total rating score for females. If the result was zero, no bias was indicated and the case was ignored. If the result was a positive number the case was counted as a bias in "probable future success" rating toward females. If the number was negative it was counted as a "probable future success" rating toward males.

Based on the analysis of data from the systematic variations in avatar, 13 of 26 teachers rated females higher, 13 of 26 teachers rated males higher, and for 14 of the teachers there were no overall differences in ratings, so these 14 cases were excluded from further analysis. This distribution of 13 female and 13 male ratings each being higher is the balance that would be expected purely by chance, so no gender bias was indicated when viewing the 40 teachers as a whole for rating of avatars representing simStudents.

Based on a parallel analysis for variations in name, 11 of 21 teachers rated females higher, 10 of 21 teachers rated males higher, and for 19 of the 40 teachers there were no overall differences in ratings, so these 19 cases were excluded from further analysis. The probability of 11 or more of 21 cases indicating teacher bias in the female rather than male direction is $p = 1.0$ (NS) as a 2-tailed test (Graphpad, 2023), if no prior conjecture is made about whether females or males might be rated higher. This outcome of no significant difference by gender in the context of alterations among names, is consistent with the finding reported in the previous paragraph, in the context of alterations among avatars.

Impact of Simulation-Provided Tips

Impact of Tips and Targeted Actions on ELL simStudents

Exploration of the ratios of number of targeted actions (targeted teaching strategies) provided during a simulation session versus the total number of tips provided by the system, led the researchers to pursue a preliminary line of research that adds context and complexity to the previously-reported tendency for simEquity teachers to rate ELL-labeled students as "less likely to succeed". First, ratios of *targeted actions taken* divided by *total tips* provided by the system were calculated for each simStudent during a 15-minute teacher simulation run, across all 40 teachers. Two of the six simStudents in one profile were labeled as ELL (see example in Table 1). Therefore, average ratios for each of the pairs were computed and analysis was completed on the average ratios for pairs among the six students. After flagging the highest of the three ratios for each teacher, a frequency count was produced recording the number of teachers where the ELL pair had the highest ratio of meaningful actions to tips provided.

The outcome of the frequency count was that 21 of 40 teachers had the highest average ratio of targeted actions taken among their ELL pair, while 17 had one of the other two pairs producing the highest ratio, and two teachers had the ELL ratio tied for highest and therefore these two cases among the 40 were excluded from further analysis. By chance we would expect 1/3 of the highest ratios to reside in each of the three profile pairs and so the binomial test of ELL began with a prior expectation of success to be 1/3 or .3333. The probability of these 21 of 38 teachers with preferences in their data indicating highest ratio of meaningful actions toward ELL students is p = .00435 (Graphpad, 2023), highly significant at the $p < .05$ level. These meaningful actions targeted toward students labeled ELL are unlikely to have been prioritized by chance.

Potential implications of this last finding are important to consider as evidence of the authenticity of extra attention devoted to ELL students by the same group of teachers we had labeled as biased in the sense of reporting ELL students as "less likely to succeed" simply because the profile showed they were ELL, yet they behaved as the other profiles in terms of academic ability and emotional stability. The broader context provided by the results considered wholistically, is that teachers (even within the simulator) recognize that ELL students often need extra

attention and they appear to be making extra effort to see that it is provided during their teaching simulation. This topic will be further addressed in the Discussion section.

Impact of Tips and Targeted Actions on Gender

Based on the ratios calculated for the first step of the analysis immediately preceding – that is, number of *targeted actions taken* divided by *total tips* provided by the system as calculated for each simStudent during a 15-minute simulation session, across all 40 teachers – a final analysis was completed comparing ratios for female simStudents to ratios for male simStudents, across all teachers. Within each pair of profiles, a frequency count of 1 was credited to the "female higher" accumulator if the ratio favored the female member of a pair, while a frequency count of 1 was credited to the "male higher" accumulator if the ratio favored the male member of a pair. No accumulation was awarded if the two ratios were equal and the analysis resulted in a tie. In this analysis, 40 teachers x 3 pairs were examined, for a total of 120 instances of analysis. Results were that the proportion of meaningful targeted actions divided by the total number of tips given was higher for female simStudents in 59 instances and higher for male simStudents in 42 instances. Eighteen instances resulted in a tie and were excluded from further analysis. The likelihood of 59 or greater of 101 action ratios being higher for female simStudents is $p = .1111$ (2-tailed) (Graphpad, 2023), which can be viewed as indicative of a trend but not significant at the $p < .05$ level. That is, these findings could have occurred by chance.

Results of this analysis indicated that simEquity teachers (while not significant) may tend to follow up on tips provided by the system with targeted actions in response, more frequently for female simStudents than for male simStudents. This would likely be judged as implicit bias if reconfirmed with a new set of data planned to be gathered during year 3 of the project. In the meantime, this trend along with the confirmed tendency for ELL-labeled students to be judged less likely to succeed by teachers, sets the stage for subsequent analysis of Year 2 data to determine whether by the fifth repetition of teaching a simclass, these tendencies for biases tend to subside. Continued analysis of the project data is planned in this area.

Discussion

The findings reported in this paper replicate findings from the previous year of the project, that teachers generally perceive ELL students as less likely to succeed after completing a simulation session with these students, even though the actual performance of the students with ELL labels was identical to their non-ELL peers. The findings reported in this paper also demonstrate that a fine line might exist between what is universally accepted as bias versus what might be termed teaching actions based on desire to help the students perceived as needing more help. In this study, apparent bias against students labeled as ELL in the form of teachers rating this group as "less likely to succeed" is accompanied by new data indicating that teachers also more frequently follow up on tips provided by the system about how to help the student learn, if the student is labeled ELL. In an actual classroom situation, it is quite likely that a student who has been designated as ELL is more likely to need additional attention in order for the student to achieve at the level of a native English speaker.

Similarly, the identified tendency toward gender bias for teacher perceptions in favor of female simStudents being characterized as "more likely to succeed" appears to coincide with research indicating females are generally better students at all K-12 levels (Gnaulati, 2014; O'Dea et al., 2018). Is this truly a bias, or does more rapid maturation in females actually tend to make them better equipped for typical pedagogical classroom teaching strategies commonly being implemented? The answers to these types of "what does this really mean" questions may be complex. It has long been known that with students as learners, it is important not to oversimplify an individual's identity based on simple categorized traits (Pollmann, 2021) because identity is much more complex than skin color, gender or preferred spoken language. Perhaps the underlying (implicit) motive the simEquity teachers have for unknowingly behaving in a biased way, may in some cases actually be driven by a deeply ingrained desire to be a good teacher.

Conclusions

During the second year of the simEquity project, data gathered within the simSchool system and provided by the teachers themselves continues to provide evidence that the simulator can serve as an unbiased training and pedagogical research administration environment. Furthermore, this environment is perceived by teachers as sufficiently authentic to provide them with teaching challenges that mirror real life teaching situations. New findings during year 2 have reiterated year 1 findings, that many teachers appear to possess implicit biases toward students labeled as ELL even if the performance characteristics of the simulated student labeled as ELL is no different from the other simulated students without this designation. New findings derived in year 2 also have shown that

simEquity teachers tend to more frequently give targeted guidance to an ELL-labeled student whenever a tip suggesting the student needs help is delivered by the system. This finding implies that teachers may be more frequently providing targeted actions to help ELL students after being prompted by a hint from the system, because teachers think these students need their help the most. Similarly, evidence of gender bias in the form of teachers rating females as "more likely to succeed" in their school work, compared to males, could possibly be based upon a research supported belief system common is K-12 schools that females are typically better students. It might also be influenced by the fact that most K-12 teachers are female. Further research is needed in this area. The findings reported in this paper lay the groundwork for the next step in the project's research, which involves assessing whether bias declines over multiple teacher trials with feedback, in the simEquity project.

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