Fostering Equitable Teaching Practices through a Simulated Teaching Environment

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Abstract This paper focuses on research based on educators' use of a simulated teaching environment and its relationship to changes in indices associated with equitable teaching practices. Data from 39 educators who spent an average of 4 hours and 39 minutes completing 15 sessions in three modules providing feedback on each session in a simulated teaching environment are included. Results indicated that there were significant and educationally meaningful positive changes in measured indices related to equitable teaching practices following experience teaching in the simSchool simulator.

Objective/Purpose

Classrooms are becoming more diverse as they reflect the society in which we live. 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, educators need to actively recognize and counter patterns of bias in their teaching practices as well as classroom environments (Chen, Nimmo, & Fraser, 2009).

The *simEquity* project was developed to be a transformative, scalable model for encouraging equitable, culturally responsive teaching practices through an artificial intelligence (AI)-driven algorithm for detecting and mitigating implicit bias in a simulated teaching environment. This project intends to identify bias-mitigation best practices that can be implemented broad scale to help teachers recognize and mitigate the influence of implicit bias on their teaching and their students' learning dispositions and academic achievement. Lessons learned could help contribute to a more just and equitable society in the future.

Theoretical Framework

This study is focused on increasing teacher self-efficacy to improve student learning. Self-efficacy is rooted in social cognitive theory (Bandura, 1977) that highlights the perspective that people are their own change agents. Teachers with a strong sense of efficacy believe student learning outcomes are within their control and are based on teacher behavior rather than outside influences (Tschannen-Moran, Hoy, & Hoy, 1998). Researchers have identified connections between teachers' sense of efficacy, culturally responsive pedagogy (Callaway, 2016), and student achievement (Oyerinde, 2008; Tucker et al., 2005). Efforts to increase teacher efficacy are vital in remediating the low academic achievement among culturally diverse students (Callaway, 2016; Tucker et al., 2005). Highly efficacious teachers have more persistence when helping struggling students, and they create lessons designed to engage their students (Bandura, 1997; Kitsantas, 2012; Protheroe, 2008).

It is imperative that educators provide a culturally responsive environment for all students to be confident in their learning (Derman-Sparks & Ramsey, 2000). Being a culturally responsive educator first requires recognition of existing or potential bias, a metacognitive skill of teaching but these are often difficult to recognize. This study focuses on using an unobtrusive environment where underlying biases can be identified, acknowledged and remediated. A

simulated teaching environment allows for comparing self-reported bias indicators to objective measures produced by teaching within the simulator.

Badiee (2012) identified four advantages to simulation based learning: (a) classroom decision-making, (b) practice through repeating, receiving feedback and advice, (c) self-efficacy in classroom teaching, and (d) collaborations and social interactions. Fischler (2006) added that simulation based learning has great potential in education by allowing educators to act within virtual environments, immediately applying theory to realistic yet controlled settings.

SimSchool is a dynamic, online classroom simulation program that allows the opportunity to practice teaching in a safe environment for experimenting and practicing techniques, especially methods of addressing different learning needs, and wide variations in academic and behavioral performance of students. Using student profiles, teachers need to be able to plan and deliver culturally responsive instructional challenges and supports that build on the strengths of students to address their learning needs (Sianjina, 2000). Teachers need to be able to assess students, analyze the results, and enable adjustments to their instruction to ensure that all students are learning and achieving higher results (Girod & Schalock, 2002).

SimSchool's inference engine draws upon several instructional models and frameworks to simulate the authentic human behaviors and reactions that one experiences when teaching in simSchool (simSchool, 2018-19). These extensively researched and validated models include: 1) Cattell-Horn-Carroll Theory of Intelligence (Schneider & McGrew, 2012); 2) OCEAN model of Emotion (McCrae & Costa, 1996); 3) Interpersonal Circumplex Theory (Smith, 2013); 4) Standard models of language learning and language proficiency used to diagnose ELL students (Phakiti, Hirsh, & Woodrow, 2013); and 5) Structural functional (Case, 1993) and social constructivist theories of learning (Dweck, 1999; Vygotsky, 1962). These models are distilled into "cognitive and behavioral states" within simulated students and "cognitive and behavioral requirements" within instructional tasks. How the student performs and behaves is a direct reflection of how well-matched expectations are to students' capabilities. Figure 1 depicts the interface of the simSchool classroom highlighting the student profiles.

Research on the use of simSchool has shown improved educator understanding in *teaching skills* (Christensen, Knezek, Tyler-Wood, & Gibson, 2011; Knezek, Hopper, Christensen, Tyler-Wood, & Gibson, 2015), *classroom management* (Christensen et al., 2007), *motivation* (Tyler-Wood et al., 2017), *multicultural awareness (*Collum, Christensen, Delicath, & Johnson, 2019), *literacy* (Collum, Christensen, Delicath, & Knezek, 2020), self-reported *educator bias* (Collum et al., 2020) and *instructional self-efficacy* (Knezek & Christensen, 2009). The key innovation of the program is that it provides teachers and teacher trainees many learning trials with simulated students, thereby increasing teacher confidence and competence, which in turn improves student learning. Repetition of many trials is important in changing habit complexes such as implicit bias (Malone, 2016).

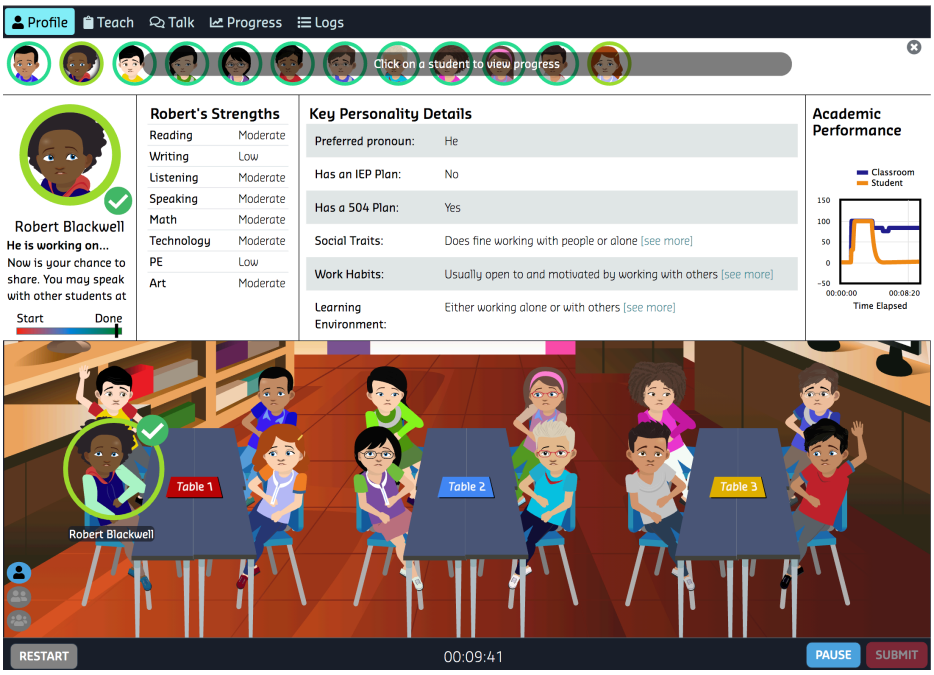


Figure 1. SimSchool classroom highlighting student profiles.

Research Question

The focus of the current study is on the changes that occurred pre-post for the teachers during completion of modules in the teaching simulator. The research question guiding this paper is:

To what extent do changes occur during multiple sessions (iterations) of participation in simulated teaching modules?

Methods

Participants

Classroom teachers were recruited from schools in two large public school systems. Thirty-nine teachers completed all the modules and data collection. Incomplete data from the educators who partially completed project requirements were not included in this study.

Teacher distribution by gender was 28 (71.8%) females and 11 (28.2%) males. The teachers reported ethnic identities included a majority White (28, 71.8%), followed by Hispanic and Asian (each 4, 10.3%), Black/AA (2, 5.1%) and Latinx (1, 2.6%). Teachers were paid a stipend for completing all components of the project. Modules are described below and were selected by district leaders to provide professional development that matched district goals.

Activities

The 39 teachers participated in one group of modules depending on the grade level taught. The listing of the modules by grade level band is shown in Table 1. Each participant first completed a tutorial module (2 sessions) to understand how to navigate simSchool. Each of the content modules required completion of at least five sessions in each module. Each session consisted of teaching the provided lesson for at least 15 minutes, reviewing provided feedback and reteaching the lesson with the goal of improvement based on the feedback. The average total amount of

time spent actively completing simulations was 4 hours and 39 minutes.

At the end of each simulation session, participants received graphical feedback displaying degree of success at promoting academic, emotional and equity performance in the simulated class overall, as well as feedback regarding the degree of suitability of the instructional activities selected for each individual simulated student in the class. Figures 2 and 3 illustrate examples of graphical feedback as well as an observation report that participants receive. Figure 4 illustrates the equity index that has been developed for this project. This feedback can reveal aspects of a teacher's implicit biases for gender and/or ethnicity.

Table 1. *Modules Completed by Classroom Teachers*

Elementary School Modules
Tutorial: Teaching in simSchool
Module 1: Cultural Intelligence and Inclusion 2.0
Module 2: Bullying and Bias the First Coconut Tree
Module 3: Gender and Identity: Supermom Saves the Day
Middle School Modules
Tutorial: Teaching in simSchool
Module 1: Gender and Identity: The Misfits
Module 2: History Empowering Learners to Change the world
Module 3: Race, Ethnicity, Class, Immigration: A Tale of Two Schools
High School Modules
Tutorial: Teaching in simSchool
Module 1: Showing Empathy
Module 2: Sounds of Change
Module 3: Why Local Elections Matter

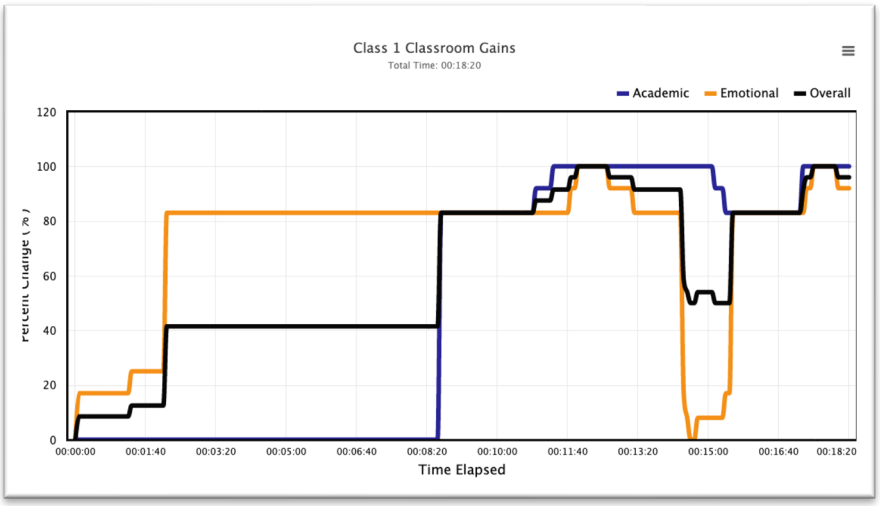
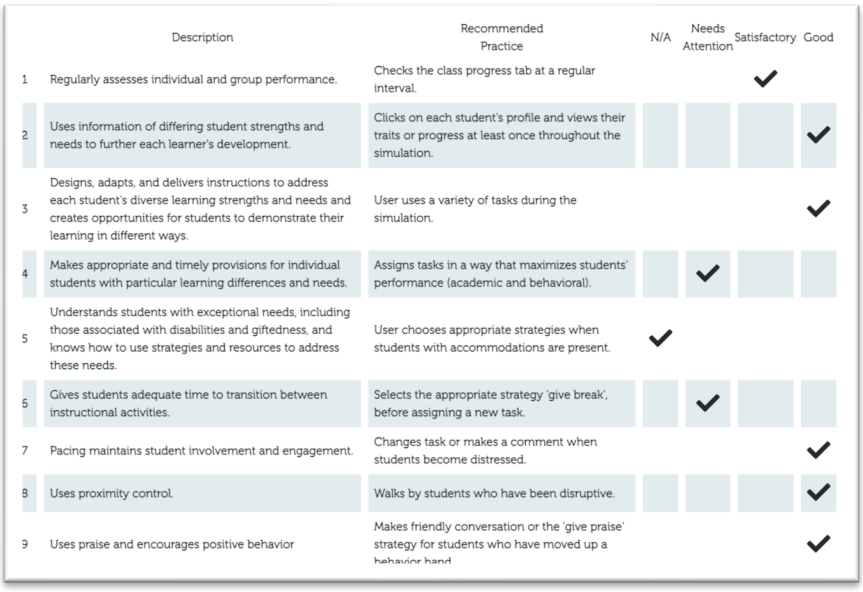


Figure 2. SimSchool graphical feedback based on interactions with students.



	Description	Recommended Practice	N/A	Needs Attention	Satisfactory	Good
1	Regularly assesses individual and group performance.	Checks the class progress tab at a regular interval.			✓	
2	Uses information of differing student strengths and needs to further each learner's development.	Clicks on each student's profile and views their traits or progress at least once throughout the simulation.				✓
3	Designs, adapts, and delivers instructions to address each student's diverse learning strengths and needs and creates opportunities for students to demonstrate their learning in different ways.	User uses a variety of tasks during the simulation.				✓
4	Makes appropriate and timely provisions for individual students with particular learning differences and needs.	Assigns tasks in a way that maximizes students' performance (academic and behavioral).		✓		
5	Understands students with exceptional needs, including those associated with disabilities and giftedness, and knows how to use strategies and resources to address these needs.	User chooses appropriate strategies when students with accommodations are present.	✓			
6	Gives students adequate time to transition between instructional activities.	Selects the appropriate strategy 'give break', before assigning a new task.		✓		
7	Pacing maintains student involvement and engagement.	Changes task or makes a comment when students become distressed.				✓
8	Uses proximity control.	Walks by students who have been disruptive.				✓
9	Uses praise and encourages positive behavior	Makes friendly conversation or the 'give praise' strategy for students who have moved up a behavior band				✓

Figure 3. SimSchool observation report based on participant actions in the simulated classroom.

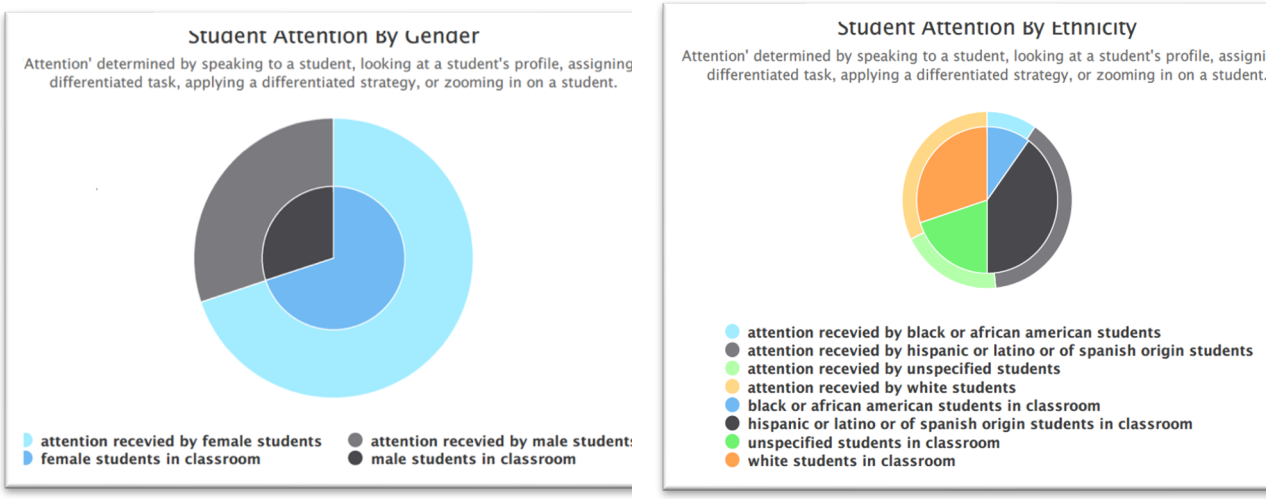


Figure 4. SimSchool equity index feedback by gender and ethnicity.

Data Sources

Data were collected within the simulator to measure pre-post changes during the modules for academic, emotional and equity performances by project participants. In addition, teacher self-report survey measures focused on self-efficacy, culturally responsive teaching, and self-awareness of bias. Student survey data were also collected following their teachers' participation in the project, but not included in this paper. Below are descriptions of the teacher surveys. Each of the surveys is rated on a 6-point Likert scale from Strongly Disagree (1) to Strongly Agree (6).

The teacher surveys included:

1. The *Teachers' Sense of Efficacy Scale* (TSES) (Tschannen-Moran & Hoy, 2001) was used to

measure self-efficacy related to three subscales: instructional strategies, classroom management, and student engagement.

2. The *Culturally Responsive Self-Efficacy Survey* (Siwatu, 2007) was included to determine the level of competency in the skills and knowledge needed to engage in culturally responsive teaching that includes curriculum, assessment, classroom management and cultural enrichment.
3. Three scales from the *Educator Bias Inventory* (Collum et al., 2020) were included. These scales include: *Self-Awareness*, *Pedagogical environment*, and *Relationships with families and communit*y. This survey was recently used with simSchool research and is based on Chen et al. (2009).

Results

Both self-report and simulation collected data were downloaded from simSchool and analyzed using paired *t*-tests to measure pre-post changes. Results are reported for the 39 teachers who completed all required components.

As shown in Table 2, there were significant (p <.05) positive changes from pre to post for Culturally Responsive Teaching Self-efficacy and two scales on the Educator Bias Inventory: Pedagogical environment and Relationship with families and communities. Effect size is a meaningful indicator for looking at educational significance. As shown in Table 4, the effect sizes were educationally meaningful at .30 and above for three of the seven measures. Fourteen of the 25 individual items on the Culturally Responsive Self-Efficacy Survey and five of the Educator Bias Inventory were significant and are shown in Table 5. Effect sizes for each of these are also included in Table 5. An additional single item related to reflection of participants' own identity was also included in the survey items. As shown in Table 6, while not significant at the p <.05 level, the effect size was .21 (Cohen's d) regarding the magnitude of the gain for this item, meaning the teachers became more reflective on their identity following the simEquity module completions.

Table 2. *Comparison of Paired Pre and Post T-tests for Equity-Related Subscales for Teachers*

Scale	PrePost	Mean	Std. Dev	Sig	Cohen's d
Teacher Efficacy (TE) for Instructional	Pre	4.98	.51		
Strategies	Post	5.06	1.1	.640	.09
Teacher Efficacy (TE) for Classroom	Pre	5.08	.58		
Management	Post	5.00	1.13	.681	-.07
Teacher Efficacy (TE) for Student Engagement	Pre	4.93	.56		
	Post	5.00	1.09	.702	.08
Culturally Responsive Teaching Self-Efficacy	Pre	4.94	.58		
Survey	Post	5.19	.55	.001	.44
Educator Bias Inventory: Self-awareness	Pre	5.32	.46		
	Post	5.38	.41	.394	.14
Educator Bias Inventory: Pedagogical	Pre	5.11	.55		
environment	Post	5.28	.50	.002	.32
Educator Bias Inventory: Relationship with	Pre	4.53	.96		
families and community	Post	4.82	.82	.006	.33

Note: n = 39; * Significant at the p = .05 level. Cohen's (1988) effect size guidelines .2 = small, .5 = moderate, .8 = large.

Table 5. *Individual Educator Items that were Significant from the Subscales*

		Mean	N	Std. Dev	p	Cohen's d
Culturally Responsive Self-Efficacy Items						
I feel confident I could…						
obtain information about my students'	CR2pre	5.08	39	.81		
academic strengths.	CR2post	5.36	39	.63	.014	.411
identify ways that the school culture (e.g.,	CR4pre	4.77	39	.87		
values, norms, and practices) is different	CR4post	5.21	39	.80	.002	.531
from my students' home culture.						
implement strategies to minimize the	CR5pre	4.46	39	1.05		
effects of the mismatch between my	CR5post	4.95	39	.94	.004	.489
students' home culture and the school						
culture.						
assess student learning using various types	CR6pre	5.03	39	.67		
of assessments.	CR6post	5.36	39	.58	.003	.503
obtain information about my students'	CR7pre	4.69	39	.95		
home life.	CR7post	5.13	39	.86	.006	.464
develop a community of learners when my	CR10pre	5.13	39	.77		
class consists of students from diverse	CR10post	5.38	39	.63	.016	.402
backgrounds.						
obtain information about my students'	CR13pre	4.82	39	.72		
cultural background.	CR13post	5.13	39	.70	.038	.345
help students to develop positive	CR16pre	5.00	39	.83		
relationships with their classmates.	CR16post	5.23	39	.71	.048	.327
revise instructional material to include a	CR17pre	4.64	39	.99		
representation of different cultural groups.	CR17post	4.92	39	.96	.032	.356
help students feel like important members	CR19pre	5.26	39	.72		
of the classroom.	CR19post	5.46	39	.56	.058	.313
identify ways that standardized tests may be	CR20pre	4.54	39	1.00		
biased towards culturally diverse students.	CR20post	4.95	39	.97	.006	.466
use examples that are familiar to students	CR21pre	4.67	39	1.03		
from diverse cultural backgrounds.	CR21post	5.05	39	.92	.014	.411
obtain information regarding my students'	CR23pre	5.13	39	.66		
academic interests.	CR23post	5.41	39	.50	.026	.372
use the interests of my students to make	CR24pre	5.05	39	.69		
learning meaningful for them.	CR24post	5.31	39	.57	.031	.359
Educator Bias Inventory Items						
I actively encourage critical thinking about	EBPE20pre	5.08	39	.74		
differences, stereotypes and biases.	EBPE20post	5.33	39	.66	.048	.327
I teach about minority and non-minority	EBPE21pre	5.00	39	.73		

groups who have devoted their lives to ending injustice.	EBPE21post	5.23	39	.67	.018	.396
I have high expectations for learning for all students.	EBPE23pre	4.87	39	.83		
	EBPE23post	5.18	39	.85	.017	.402
I provide the option of translations for families who do not speak English.	EBRF25pre	4.44	39	1.55		
	EBRF25 post	4.79	39	1.08	.046	.330
I include families in creating the learning environment for children.	EBRF27 pre	4.36	39	1.35		
	EBRF27 post	4.69	39	1.20	.036	.349

Table 6. *Pre and Post Paired Means for Reflection on Own Identity*

Reflection Item	PrePost	Mean	N	Std. Dev	Sig	ES
I reflect on how my own identity influences my interactions with students.	Pre	4.85	39	1.01		
	Post	5.05	39	.86	.210	.21

Results from the Simulation Data

Teaching behaviors are captured within the simSchool system that allow computation of academic gains, emotional gains, and equality gains while teaching within a module. In addition, ratings for "How likely to succeed in future lessons" were also recorded in the system by each teacher for each of the 12 simStudents in a teacher's class. These were presented to the teachers following the first 15-minute simulation, and the last (fifth)15-minute simulation, for each of the three modules. Separate ratings were completed by each teacher, first based on just reflecting on the image of each simStudent (Avatar featuring different skin tones) and then based on name of the student with no image.

Trends for the major findings within and across modules are presented in Table 7 and graphically highlighted in Figures 5-7. Across the three modules completed by each teacher, from the first time of capturing data at the end of completing the first 15-minute simulation (of 5) for Module 1, to the end of the last 15-minute simulation (of 5) for Module 3, the overall gains shown in Table 7 and graphically displayed in Figures 5, 6, and 7 were highly significant (p <.005) for Academic Index (ES = .42), Avatar Rating (ES = .37), and Name Rating (ES = .29). The magnitudes of these gains are at or beyond levels that would be widely accepted as educationally meaningful in the research literature (Bialo & Sivin-Kachala,1996). The simulator-produced Emotional Index and Equality Index showed non-significant (at the $p < .05$ level) positive gains overall with effect sizes of ES = .08 and ES = .07 respectively. These would be considered small positive effects by Cohen (1988) and would be considered "Developmental Effects" (0 - .1) by Hattie (2009).

Within each module there were differences that are beginning to emerge and will be studied in more detail. Specifically, for Module 1, First to Last Academic, Emotional, Equality and Avatar plus Name ratings all become more positive from the first of five simulations to the last of five simulations, and all but the Equality Index gains were significant ($p < .05$). Within Module 2, Teachers appear to have concentrated on Academic Gains ($p < .0005$, ES = .41). They began on the first simulation in M2 near the same level of proficiency as where they began (with

a different lesson to teach) in M1, but advanced more. None of the other indices changed significantly ($p < .05$) and magnitude/ES was typically very small in M2. In Module 3, with a third new lesson to teach, educators held steady at what we can now call a "high" level of First and Last in Academic Index (.85 vs. .72 in the beginning), Avatar Ratings and Name ratings (3.7+ vs. <=3.4 in the beginning). Mean ratings in these three areas changed little first to last simulation. Teachers advanced first to last significantly ($p < .05$) in the areas of Emotional Index and Equality Index but the magnitude/ES was ES = .12 and ES = .09, small per Cohen (1988). Note that these latter two areas were the only ones without significant gains in Module 1.

Table 7. *Simulation Data Gains for Academic, Emotional and Equality Gains by Module*

Module Number	**First Measure**	**Last Measure**
	First Academic Index	*Last Academic Index*
M1	.7170	.8108
M2	.7262	.8505
M3	.8551	.8549
	First Emotional Index	*Last Emotional Index*
M1	.1897	.2465
M2	.2954	.2615
M3	.1813	.2195
	First Equality Index	*Last Equality Index*
M1	.9880	.9885
M2	.9892	.9879
M3	.9869	.9887
	First Avatar Rating	*Last Avatar Rating*
M1	3.32	3.60
M2	3.60	3.56
M3	3.78	3.77
	First Name Rating	*Last Name Rating*
M1	3.40	3.63
M2	3.61	3.66
M3	3.70	3.74

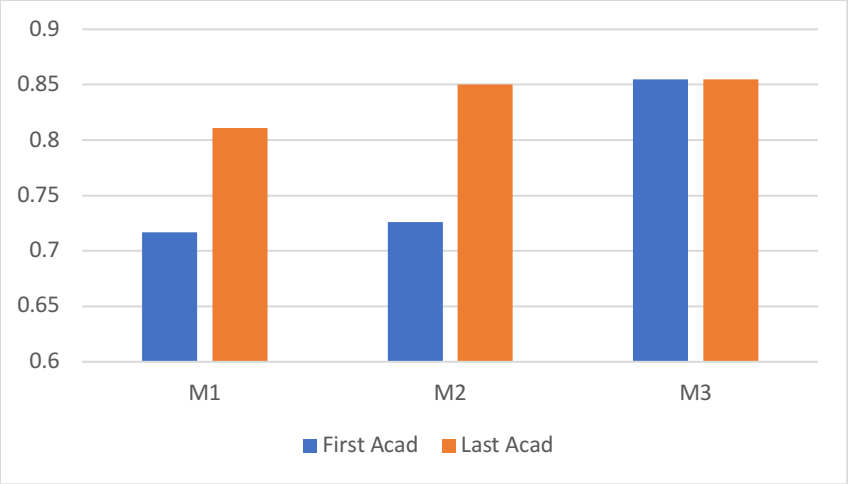


Figure 5. SimSchool Academic Index group mean values for M1, M2 and M3.

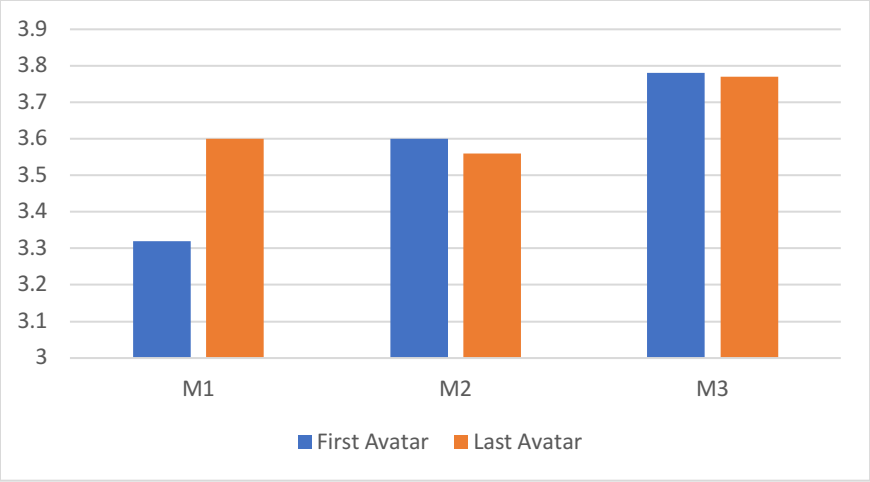


Figure 6. SimSchool Avatar Rating group mean values for M1, M2 and M3.

Figure 7. SimSchool SimSchool Name Rating group mean values for M1, M2 and M3.

Summary

There were significant (p <.05) positive changes from pre to post for self-reported teacher efficacy related to instructional strategies as well as culturally responsive teaching. The effect sizes for each of the 7 subscales were educationally meaningful at .30 and above. The simulation data showed positive changes for most of modules for academic, emotional and equality teaching. Interestingly, module 3 showed significant (p <.05) positive gains on the equity index but not on the academic and emotional gains. With a larger sample, the team plans to validate simulation data with self-report data. These initial findings indicate that educators showed positive gains after participation in a simulated teaching environment.

Limitations of the current data set include analyses on a relatively small number of teachers and a limited set of data points from the simulator. In addition, the small range of changes permitted in the equity index made it difficult to draw conclusions. Input from experts in equity are being consulted to update the equity index and validate it for subsequent years. In addition, data will be collected in year two of the project to provide from a larger sample of teachers (n=60) to allow the team to study several areas more in depth, such as whether different module topics impact outcomes, framing expectations of students, implementation of AI assistants to provide real-time interactions during simulations, and personalized feedback with instructive, concrete ideas of how to decrease bias while teaching (based on their simulated teaching).

Significance of the Study/Educational Importance

Simulations offer many possibilities as a pedagogical approach for teacher professional development related to equity-based teaching practices and are increasingly being used to approximate various teaching scenarios and support the transfer of learning into classroom situations (Dalinger, Thomas, Stansberry, & Xiu, 2020). Most research on simulations for teacher education that focus on equitable teaching practices include human actors (Cohen, Wong, Krishnamachari, & Berlin, 2020), a type of simulation that is not affordable or sustainable for large groups of educators. SimSchool provides a fully digital environment for supporting the improvement of teacher practices related to equity.

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