

Using a Simulated Teaching Environment to Improve Equitable Teaching Practices

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Abstract This paper focuses on educators' use of a simulated teaching environment and its relationship to changes in indices associated with equitable teaching practices. Pre-post survey data were gathered from 39 educators who spent an average of 4 hours and 45 minutes completing 17 sessions in four modules in an online simulated teaching program. Participants were provided with feedback following each session with the intention of improving their performance in subsequent sessions. Results indicated that there were significant and educationally meaningful positive changes in measured indices related to equitable teaching practices following online simulated teaching experiences.

Keywords: equitable teaching, simulated teaching environment, simSchool

Introduction

Classrooms are becoming more diverse as they reflect the society in which we live. Gender, ethnicity, socioeconomic status, and English language learning status have all 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 et al., 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. Through this project, data from both self-report pre-post surveys and data generated from user responses in the simulation system can be combined to determine how teaching in a simulated teaching environment can lead to more equitable teaching practices through unobtrusive and targeted feedback.

Theoretical Framework

This study is grounded in the principle of 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 (Tschanne-Moran et al., 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. While the use of simulator programs in other professions has been widely used, this powerful tool has been slow to penetrate the education profession, especially professional development (Ledger et al., 2024).

The simulated professional development system chosen for this study is simSchool. 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 can 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 et al., 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 et al., 2011; Knezek et al., 2015), *classroom management* (Christensen et al., 2007), *motivation* (Tyler-Wood et al., 2017), *multicultural awareness* (Collum et al., 2019), differentiated instruction for diverse learners (Johnston & Collum, 2018), *literacy* (Collum et al., 2020), self-reported *educator bias* (Christensen 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). Previous research has shown that using simulation-based avatars as students, combined with feedback, significantly improves preservice teachers' self-efficacy (Samuelsson et al., 2022). Researchers who conducted a systematic literature review focused on using simulations in teacher education concluded that simulations can strengthen pre-service teachers' beliefs in their teaching abilities and add value to the teacher education process (Theelan et al., 2019).

While most of the studies on simulation for teacher education have focused on pre-service teachers (Ledger et al., 2024), this study focuses on teachers who are currently in the classroom. One of the strengths of computer-based simulation programs is the opportunity for practicing teachers to participate in professional development on their own time with targeted feedback and reflection.

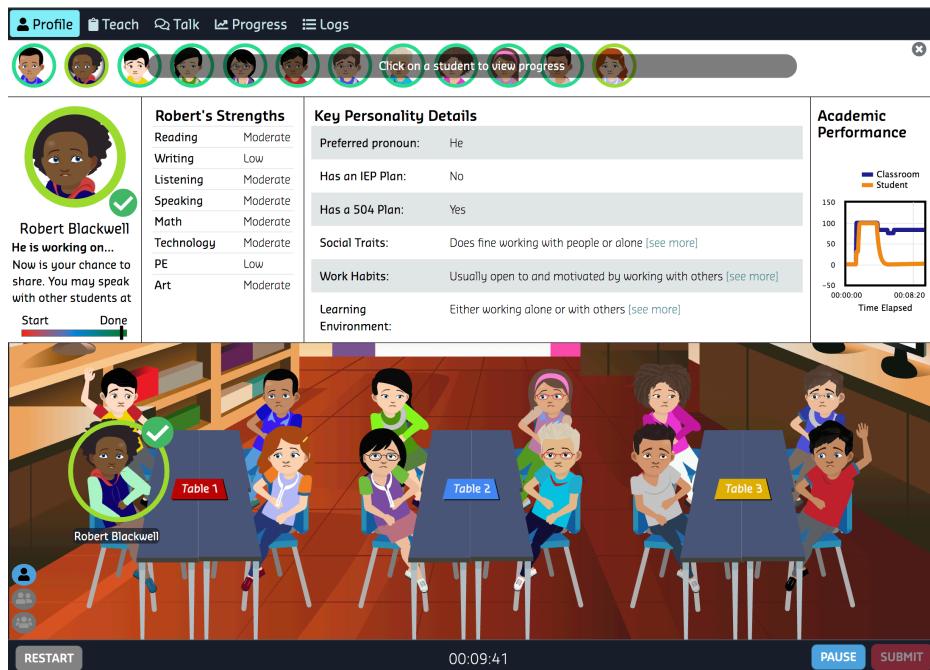


Figure 1. SimSchool classroom highlighting student profiles.

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 questions guiding this study were:

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

- Changes in teaching efficacy
- Changes in culturally responsive teaching practices
- Changes in educator bias indicators

The Study

The study aimed at using a computer-based online simulated teaching environment to improve equitable teaching practices with the goal of improving instruction, as well as dispositions. University ethics approval was obtained to recruit participants and collect data from both teachers and students. Participants were recruited from two school systems via email sent by administrative contacts at the school systems. Participants were provided a stipend upon completion of all required components of the project including a self-report pretest teacher survey, asking their students to complete a pretest survey, completing four modules of the simulated teaching program, collecting post test data from their students, and completing a self-report posttest teacher survey. The school system in California participated in Fall 2022 and the school system in Texas participated in Spring 2023. Each site completed the cycle of pre-post surveys and modules in approximately six weeks.

Methods

Participants

Complete data that included pre-post self-report surveys for the teachers who completed all of the required components was used for the analysis in this report. The data set included 23 teachers from the California location and 16 teachers from the Texas location from K-12 schools. The grade levels were coded as elementary ($n = 11$, 28.2%), middle school ($n = 10$, 25.6%) and high school ($n = 18$, 46.2%). Twenty-eight (71.8%) of the teachers reported being female and

eleven (28.2%) of the teachers reported being male. The average number of years of teaching was 11.6 with a range from 2 to 37 years and with 80.6% having taught 5 or more years.

Intervention

The 39 teachers participated in a specific set 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 an introductory module to understand how to navigate simSchool. Each of the content modules required completion of at least five sessions of a 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 minimum amount of time that was required was 4 hours and the average total amount of time spent actively completing simulations was 4 hours and 45 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 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 equality index that has been developed for this project. This graphic feedback can reveal aspects of a teacher's implicit biases regarding gender and/or ethnicity. The observation report shows areas needed for growth that participants can focus on in subsequent simulation sessions using the same students and lesson plan.

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

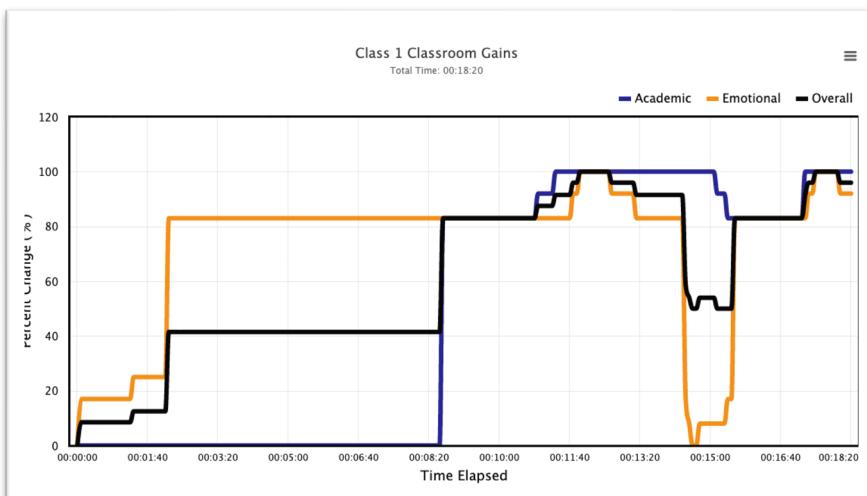


Figure 2. SimSchool graphical feedback based on interactions with students.

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.

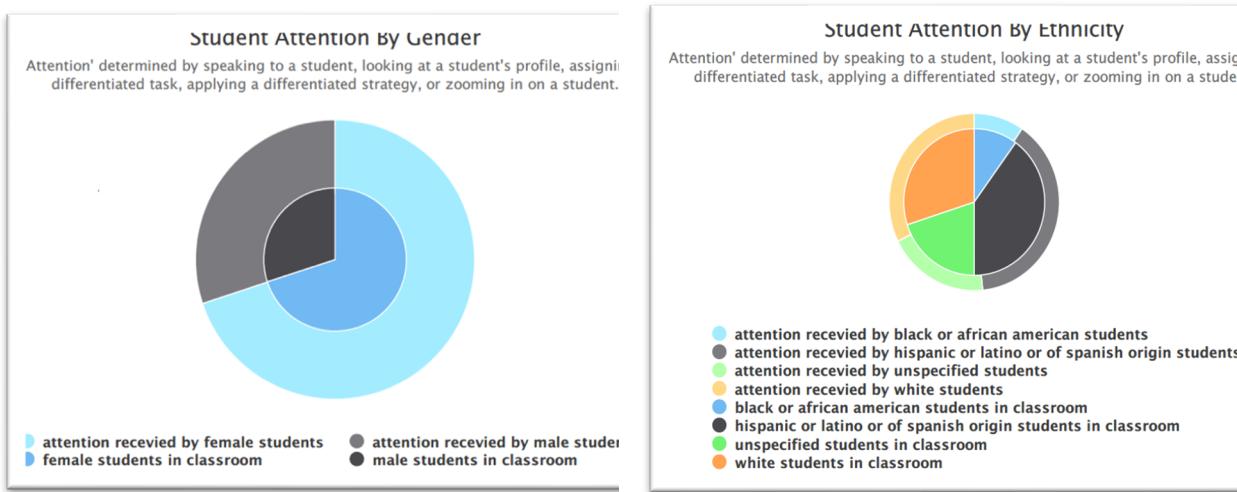


Figure 4. SimSchool equity index feedback by gender and ethnicity.

Data Sources

Two types of data were collected including self-report pre-post data as well as data captured within the simulator to measure changes during the modules for academic, emotional and equality performances by project participants. This paper examines only the self-reported teacher data, using 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 and detailed in a separate publication (Christensen & Knezek, in press). 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). Reliability estimates were calculated and are listed in Table 2. Internal consistency reliabilities for scales ranged from very good to excellent according to guidelines produced by DeVellis (2012).

The teacher surveys include:

1. The *Teachers' Sense of Efficacy Scale* (TSES) (Tschannen-Moran & Hoy, 2001) contains 24 items was used to

measure self-efficacy related to three subscales: instructional strategies (8 items), classroom management (8 items), and student engagement (8 items).

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 (29 items) from the (Collum et al., 2020) were administered. These scales included: *Self-Awareness*, *Pedagogical environment*, and *Relationships with families and community*. This survey was recently used with simSchool research and is based on Chen et al. (2009).

Table 2. Reliability Estimates for Scales Use for Pre-Post Teacher Surveys

Scales	No. items	Alpha Pre	Alpha Post
Teachers' Sense of Efficacy: Instructional Strategies	8	.895	.917
Teachers' Sense of Efficacy Classroom Management	8	.920	.936
Teachers' Sense of Efficacy: Student Engagement	8	.877	.924
Culturally Responsive Self-Efficacy Survey	25	.949	.960
Educator Bias Inventory Self-Awareness	9	.664	.665
Educator Bias Inventory Pedagogical Environment	14	.883	.891
Educator Bias Inventory Relationships with Families and Community	6	.867	.865

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 3, there were significant ($p <.05$) positive changes from pre to post for Culturally Responsive Teaching Self-efficacy, *Educator Bias Inventory* subscale of *Pedagogical environment* and *Educator Bias Inventory* subscale of *Relationships with Family and Community*. Effect sizes were also calculated as a meaningful indicator of change. As shown in Table 2, effect sizes three of the measures were also educationally meaningful (Bialo & Sivin-Kachala, 1996) at .30 and above. Individual items were also analyzed with 19 of the individual items significant ($p <.05$) from pre to post. An additional single item related to reflection of participants' own identity was also included in the survey items (Table 3). While the item was not significant at the $p <.05$ level, the effect size was .21 indicating the teachers became more reflective on their identity following the simEquity module completions.

To take a deeper look into the types of items that changed from pre to post simulated professional development intervention, individual items were analyzed. The items that were significant ($p <.05$) pre to post are included in Table 4. Looking at individual items provides more feedback regarding the specific actions within the simulated experiences that may have been impactful. For example, many of the significantly increased items on the culturally responsive self-efficacy survey included knowing more about their students' background, learning strengths, and strategies to improve student learning. For the educator bias inventory items, those that improved significantly ($p <.05$) pre to post included items about embracing different cultures in their community, high expectations for all students and more culturally aware teaching practices.

Table 3. Comparison of Paired Pre and Post *T*-tests for Equity-Related Subscales for Teachers

Scale	PrePost		Sig	Cohen's d
	Mean	Std. Dev		
Teacher Efficacy (TE) for Instructional Strategies	Pre	4.98	.51	.09
	Post	5.06	1.1	
Teacher Efficacy (TE) for Classroom Management	Pre	5.08	.58	-.07
	Post	5.00	1.13	
Teacher Efficacy (TE) for Student Engagement	Pre	4.93	.56	.08
	Post	5.00	1.09	
Culturally Responsive Teaching Self-Efficacy Survey	Pre	4.94	.58	.44
	Post	5.19	.55	
Educator Bias Inventory: Self-awareness	Pre	5.32	.46	.14
	Post	5.38	.41	
Educator Bias Inventory: Pedagogical environment	Pre	5.11	.55	

Educator Bias Inventory: Relationship with families and community	Post	5.28	.50	.002	.32
	Pre	4.53	.96		
	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 4. Individual Educator Items that were Significant from the Subscales

		Mean	N	Std. Dev	p	Cohen 's d
Culturally Responsive Self-Efficacy Items						
<i>I feel confident I could...</i>						
obtain information about my students' academic strengths.	CR2pre	5.08	39	.81		
	CR2post	5.36	39	.63	.014	.411
identify ways that the school culture (e.g., values, norms, and practices) is different from my students' home culture.	CR4pre	4.77	39	.87		
	CR4post	5.21	39	.80	.002	.531
implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture.	CR5pre	4.46	39	1.05		
	CR5post	4.95	39	.94	.004	.489
assess student learning using various types of assessments.	CR6pre	5.03	39	.67		
	CR6post	5.36	39	.58	.003	.503
obtain information about my students' home life.	CR7pre	4.69	39	.95		
	CR7post	5.13	39	.86	.006	.464
develop a community of learners when my class consists of students from diverse backgrounds.	CR10pre	5.13	39	.77		
	CR10post	5.38	39	.63	.016	.402
obtain information about my students' cultural background.	CR13pre	4.82	39	.72		
	CR13post	5.13	39	.70	.038	.345
help students to develop positive relationships with their classmates.	CR16pre	5.00	39	.83		
	CR16post	5.23	39	.71	.048	.327
revise instructional material to include a representation of different cultural groups.	CR17pre	4.64	39	.99		
	CR17post	4.92	39	.96	.032	.356
help students feel like important members of the classroom.	CR19pre	5.26	39	.72		
	CR19post	5.46	39	.56	.058	.313
identify ways that standardized tests may be biased towards culturally diverse students.	CR20pre	4.54	39	1.00		
	CR20post	4.95	39	.97	.006	.466
use examples that are familiar to students from diverse cultural backgrounds.	CR21pre	4.67	39	1.03		
	CR21post	5.05	39	.92	.014	.411
obtain information regarding my students' academic interests.	CR23pre	5.13	39	.66		
	CR23post	5.41	39	.50	.026	.372
use the interests of my students to make learning meaningful for them.	CR24pre	5.05	39	.69		
	CR24post	5.31	39	.57	.031	.359
Educator Bias Inventory Items						
I actively encourage critical thinking about differences, stereotypes and biases.	EBPE20pre	5.08	39	.74		
	EBPE20post	5.33	39	.66	.048	.327
I teach about minority and non-minority groups who have devoted their lives to ending injustice.	EBPE21pre	5.00	39	.73		
	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 5. 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

Summary

There were significant ($p <.05$) positive changes from pre to post for participants related to culturally responsive teaching and educator bias. The effect sizes for three of the seven subscales were educationally meaningful at .30 and above. These initial findings indicate that educators showed positive gains after participation in a simulated teaching environment. Detailed examination of specific items that changed significantly pre to post experience in the simulated environment showed changes in knowing more about their students' background, learning strengths, strategies to improve student learning, embracing different cultures in their community, high expectations for all students and more culturally aware teaching practices.

A possible limitation of the study is the lack of information about what other influences could have occurred during the 6 – 8 weeks that teachers were completing the simulation modules. In addition, the teachers all opted into the professional development opportunity and no data were gathered from non-intervention teachers.

Implications in Education

Simulations have been shown to help develop teaching and classroom management skills that transfer to the real classroom (Alkan et al., 2024). 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 et al., 2020). Most research on simulations for teacher education that focus on equitable teaching practices include human actors (Cohen et al., 2020), a type of simulation that is not affordable or sustainable for large groups of educators which also requires scheduling sessions in advance with limited time selections (Sasaki et al., 2020). SimSchool provides a fully online computer environment for supporting the improvement of teacher practices related to classroom management, equity, culturally responsive teaching practices and self-efficacy.

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