

## TEACHLIVE™ REHEARSALS: ONE HBCU'S STUDY ON PROSPECTIVE TEACHERS' REFORMED INSTRUCTIONAL PRACTICES AND THEIR MATHEMATICAL AFFECT

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*Scholars posit that descriptive education research that focuses on the instructional dynamic between teachers and students is perhaps one the most salient research topics that can improve learning and teaching. This case study seeks to describe prospective teachers' mathematical affect as they engage in "rehearse teaching" in TeachLivE™, a mixed-reality simulated classroom. Utilizing Goldin et al.'s (2011) engagement structures as evidence of mathematical affect, findings reveal that simulated rehearsals improve prospective teachers' reformed-based teaching and that this improvement may be related to their improved 'in-the-moment' affective states. This study potentially connects prospective teachers' beliefs and emotions as math learners with their behaviors and instructional praxes as novice math teachers.*

Keywords: Affect, Emotion, Beliefs, and Attitudes, Teacher Education-Preservice, Equity and Diversity

### Introduction

In the United States, policymakers, educational researchers and practitioners agree that one of the most important in-school predictors of mathematics student achievement is access to quality teachers (Ingersoll & Perda, 2010). It follows then that the precursor to teacher quality is quality pre-service teacher preparation (Ronfeldt, 2012). Quality pre-service teacher preparation includes rigorous foundational and methods of instruction coursework, opportunities to practice teaching, evaluation and feedback from expert mentor teachers and clinical faculty, revision of instruction and then more clinical practice to engender reflection, informed decision-making, and confidence in teaching performance (Chassels & Melville, 2009; Wilkins, 2002).

However, obtaining optimum opportunities to practice mathematics teaching in public schools remains challenging for teacher preparation programs, particularly in urban districts that serve underprivileged students (Ronfeldt, 2012). First, effective mathematics teachers who may serve as mentors must be recruited and developed; this can be difficult in urban districts where recruiting and retaining quality mathematics teachers is a challenge (Liu, Rosenstein, Swan, & Khalil, 2008; Khalil & Griffen, 2012). Second, the tenuous climate generated by the pressure of student performance on standardized testing narrows the window for innovative practice teaching (Beswick, 2006), particularly in urban districts that often face higher stakes with regards to student achievement on standardized tests (e.g. school closures and turn-around schools) (Sadovnik, O'Day, Bohrnstedt, & Borman, 2013). These conditions may then lead to a school climate that encourages more traditional ways of teaching and test preparation via scripted curriculum and less on teaching utilizing evidenced-based best practices often touted in teacher preparation programs (e.g. engaging students in reform-based teaching that is based on inquiry and conceptually challenging high cognitive demand tasks) (Ottmar, Rimm-Kaufman, Berry, & Larsen, 2013; Wilkins, 2002). Third, the advent of teacher evaluation systems has fostered concerns in potential mentor teachers who worry about the negative impact practice teaching may have on student performance on standardized tests, which in

turn may reflect poorly on their own teacher performance evaluations. Such poor evaluations may be more of a concern for elementary teachers who already struggle to teach mathematics (Ma, 1999) and whose negative affect has already been connected to their traditional instructional praxes (Wilkins, 2002).

Thus, for teacher preparation programs that seek to offer clinical experiences to prospective teachers, quality placements that provide the variety of resources and supports essential to pre-service teacher (PST) development of math teaching performance may be at a premium. Since research posits that clinical experiences are essential to teacher development, one solution to the shortage of quality placements may be simulated virtual classrooms. One key benefit of simulated clinical experiences is the feedback PSTs receive that encourages reflection and critical analysis of their teaching performance. The importance of this facet of practice teaching has been repeatedly emphasized in the literature on feedback and improved teaching performance among student teachers (e.g. see Voerman, Meijer, Korthagen, & Simons, 2012). Furthermore, Akkuzu's (2014) study illustrates that quality feedback not only improves teaching performance but that it also enhances preservice teachers' affect, specifically their self-efficacy beliefs about teaching. This research is noteworthy as other studies highlight the influence negative affect can have (e.g. low self-efficacy and anxiety) on novice elementary teachers' experience while teaching mathematics.

This paper seeks to suggest that simulated teaching experiences such *TeachLivE*<sup>TM</sup> may serve as a worthy substitute for live classroom practicum teaching as a means of developing PST's instructional practices. Furthermore, simulated classrooms may ultimately be more conducive to improving overall performance of pre-service teachers prior to the student teaching experience (Dieker, Rodriguez, Lignugaris, Hynes, & Hughes, 2014). To examine the potential impact of simulated field experiences on teacher practice, the authors explored how *TeachLivE*<sup>TM</sup> offers an opportunity to observe and respond to PSTs' "in-the-moment" affective behaviors patterns while the PST engaged in rehearse teaching of a math lesson. Additionally, the authors seek to further understand *how* improved teaching knowledge and practice may be related to affect among PSTs (Wilkins, 2002).

### Perspectives

This paper is grounded in two bodies of theory and research: the work on prospective teachers' rehearsals as clinical practice (Lampert, Franke, Kazemi, & Crowe, 2013) and on powerful mathematical affect (Goldin, 2014; McLeod, 1992). First, this study analyzes PST reformed-based teaching while they "rehearse" teaching a math lesson in a simulated clinical environment (Dieker et al., 2014; Lampert et al., 2013; Ronfeldt, 2012). Lampert and colleagues describe rehearsals as "a social setting for building novice' commitment to teach ambitiously" where the motivation to do so "depends on the social circumstances in which one learns and develops an identity" (p.227). This is consistent with Ronfeldt's (2012) assertion that optimal conditions for clinical work are essential as they are positively linked to improved teacher retention and student achievement. Furthermore, opportunities that permit PSTs to re-teach a lesson after receiving feedback and making revisions was found to benefit PSTs praxes in becoming more student-centered and reform-based (Chassels & Melville, 2009; Ganesh & Matteson, 2010). While, rehearsals of teaching is optimally conducted in an actual classroom where PSTs' can shape teaching identities within conditions that provide resources and support, such conditions are challenging to identify within inner cities (Ronfeldt, 2012). Therefore, this research explores the viability of a simulated classroom for rehearse teaching in an 'optimal' setting as a mean of examining simulated rehearsals' potential to improve PSTs' teaching performance.

Second, this paper utilizes Goldin, Epstein, Schorr, and Warner's (2011) "engagement structures" as evidence of PSTs' "in-the-moment" affective states experienced when interacting with mathematics. This paper posits that while "engagement structures" (ES) were first theorized to

characterize inner-city's "behavioral/affective/social constellation," this theory can *also* describe pre- and in-service "in-the-moment" teacher affect (Khalil & Johnson, 2016). Evidence of nine of Goldin and colleague's engagement structures were noted (e.g. *get the job done, look how smart I am, check this out, I'm really into this, don't disrespect me, stay out of trouble, it's not fair, and let me teach you*), where evidence of each structure's "in-the-moment" transaction was unpacked via seven strands (e.g. *goal or motivating desire, patterns of behavior, affective pathways, expression of affect, meanings encoded by emotions, meta-affect, self-talk or inner-speech*) (Goldin et al., 2011, p. 549). Exploring more about PSTs' "in-the-moment" affective states while teaching may lead to: a) further understanding of PSTs' affective traits, which are often negative (e.g. math anxiety and low self-efficacy) among elementary teachers teaching math, and b) improving PSTs' affective traits in an effort to encourage further reformed-based innovative teaching practices linked with positive affective traits (Wilkins, 2002).

## Data and Methods

### Study Design

This study draws on a larger mixed-method study which sought to explore the effect of pre-service teachers engaging in a lesson study project in which they planned and rehearsed a math lesson, received feedback that informed revisions of their lesson plan, and then taught the revised lesson (Hiebert, Morris, Berk, & Jansen, 2007). The PSTs worked through multiple cycles of lesson planning prior to their rehearsals. Data collected in the larger study included pre and post measures of PSTs' *Mathematics Teaching Self-Efficacy Survey* (MTEBI scores; Enochs, Smith, & Huinker, 2000), qualitative and quantitative video analysis, PSTs' reflections, as well as other course artifacts.

The lesson study took place during the fall of 2014 in an elementary mathematics methods and practicum course at Howard University, a Historically Black University with a mission to educate underserved populations of color. The first author served as the mathematics teacher educator for the four-credit mathematics methods class. Prospective teachers were required to spend 32 hours in the classroom and 32 hours in clinical settings that offered extensive opportunity for feedback (e.g. university supervisor, cooperating teacher, teacher-educators). The teacher educator asked PSTs to design a 90-minute lesson based on one CCSSM standard, as research shows that PSTs' focus on how to teach as opposed to what to teach when a topic is chosen for them (Deiker et al., 2014). Fractions (Lee & Boyadzhiev, 2013) were chosen as a conceptually challenging topic and PSTs were instructed to design their lesson plan using the 5-E Learning Cycle (Bybee et al., 2006). PSTs received feedback on lesson plans multiple times, as teaching fractions in a conceptually engaging way is challenging.

For this paper's focus on *TeachLivE*<sup>TM</sup> rehearsals, 11 PSTs (10 females; 1 male; all African-American) participated in the portion of the study reported here. PSTs took the course twice a week for two hours. All participants were 3<sup>rd</sup> year (Junior Level) students who were completing the requirements of a Bachelor's Degree for an Elementary Education Major. PSTs were asked to choose 15 min from their lesson plan to rehearse in *TeachLivE*<sup>TM</sup>, as it has been shown that 7 minutes practicing specific teaching strategies with feedback can improve teaching performance. PSTs videotaped rehearsing the 15-minute segment of instruction in *TeachLivE*<sup>TM</sup> then received feedback from two teacher educators. PSTs reflected upon their experience of lesson planning and teaching, revised a portion of their lesson plan to reteach in *TeachLivE*<sup>TM</sup>, and then rehearsed the same 15-minute segment. This amounted to 30 minutes of rehearsal teaching and two rounds of feedback from two instructors).

### Research Question and Data

The primary question driving this study is, "in what ways can rehearsals in a simulated clinical

environment like *TeachLivE™* be used as a tool to develop prospective teacher practice and powerful mathematical affect?" Qualitative data was collected and analyzed to explore the patterns and themes of PSTs' instructional practices and affective states while teaching in TeachLivE™. Data analysis involved both a) contextual analysis of each PST's reflections, videos, and video transcripts, and b) cross-teacher analysis to compare evidence of each data point among PSTs. To establish inter-rater reliability, all coding was completed by two research assistants (Creswell, 2009). The researchers first coded videos, video transcripts, and reflections deductively by searching for instances of the 9 engagement structures, then re-coded to find evidence of each structure's "in-the-moment" transaction by searching for the aforementioned 7 strands that comprise an engagement structure (Goldin et al., 2011).

Additionally, quantitative data analysis was used to measure PSTs' reformed instructional practices. To establish inter-rater reliability, two research assistants used the Reformed Teacher Observation Protocol (RTOP; Piburn et al., 2000), observed videos of the rehearsals twice to assign scores that represent PSTs' instructional practices. RTOP provides a standardized means for detecting the degree to which classroom instruction/teaching praxes is learner-centered or engaged versus teacher-centered. RTOP includes five subscales. First, lesson design and implementation (LDI) seeks to measure what the PST intends to do. Items examine how the PST organizes the lesson to honor students' preconceptions constructed from every day experiences or previous instruction and examines how the PST creates opportunities to explore aspects of the topic prior to formal instruction. Second, the propositional pedagogic knowledge (PPK) seeks to measure what the PST knows, and how well s/he is able to organize and present material in a learner-oriented setting. Third, the procedural pedagogic knowledge (PK) seeks to measure what the student avatars did and how engaged they were in critical thinking skills advocated in the CCSSM standards of practice. Fourth, the student-student interaction (SSI) subscale measures the type of interactions among students and how the PST facilitates such interactions. Finally, the fifth subscale measures student-instructor interaction (SII), and how a PST creates learning environments where students are able to take risks asking questions. Questioning provides students the opportunity to exercise executive control over their learning process, empowers their learning, and increases their overall learning gains (Boykin & Noguera, 2011).

RTOP is one of the few validated observation tools that measure reformed-based teaching (also referred to as standards-based teaching; see Ottmar, Rimm-Kaufman, Berry, & Larsen, 2013 for further details). Reform-based teaching advocates that classes be "*taught via the kinds of constructivist, inquiry-based methods advocated by professional organizations and researchers*" (Piburn et al., 2000). Reform-based teaching is a paradigm adopted by the standards movement due to its goals of shifting traditional teacher-centered lecture-driven instruction to student-centered, activity-based learning which encourages collaboration among students (Ottmar, Rimm-Kaufman, Berry, & Larsen, 2013). The original RTOP protocol was modified to adjust for the limitations of the simulated rehearsals. Figure 1 below explains the modified interpretation of RTOP Scores (adapted for the simulated rehearsal experience).

Understanding TeachLivE RTOP Scores (Adapted for the Simulated Teaching Experience)		
Traditional Lecture	Active lecture	Active Learning
RTOP Scores 0-22	RTOP Score: 23—38	RTOP Score: 38+ (out of 77)

**Figure 1.** RTOP Score Meanings.

### Results and Discussion

A descriptive analysis revealed that preservice teachers had an average RTOP score of 41.5 in their first teaching rehearsal in TeachLivE. This improved to an average score of 47.56 during the

second rehearsal in TeachLive. According to figure 1, PSTs are implementing inquiry-based methods that promote active student-centered learning on average. Table 1 below provides the descriptive statistics for RTOP and the respective RTOP subscales at Time 1 and Time 2.

**Table 1: Descriptive Statistics**

Subscale	N	Minimum	Maximum	Mean	Std. Deviation
LDI1	10	5	14	7.50	2.64
LDI2	9	4	14	8.22	3.19
PPK1	10	6	13	9.60	2.32
PPK2	9	5	14	11.11	3.14
PCK1	10	2	11	7.90	2.81
PCK2	9	3	11	9.00	2.50
SSI1	10	5	14	7.50	2.72
SSI2	9	5	16	8.67	3.54
SII1	10	5	15	9.00	3.16
SII2	9	5	15	10.56	3.17
RTOP Time 1	10	23	67	41.50	12.47
RTOP Time 2	9	22	68	47.56	13.95

### Improved Reformed Teaching: Evidence from Rehearsals

A paired-samples *t*-test was conducted to compare each subscale score of the RTOP at Time 1 and Time 2. There was a significant difference in Propositional Knowledge between Time 1 ( $M=9.60$ ,  $SD=2.32$ ) and Time 2 ( $M=11.11$ ,  $SD=3.14$ );  $t(8) = -2.600$ ,  $p = .032$ . While scores did significantly improve, PSTs' propositional knowledge is one of the greatest challenges observed during the lesson study and required a large part of the class time. This is not unusual, as elementary PSTs need support for constructing their understanding of teaching mathematics from a procedural approach to a conceptual one. There was a significant difference in Student-Student Interaction between Time 1 ( $M=7.50$ ,  $SD=2.72$ ) and Time 2 ( $M=8.67$ ,  $SD=3.54$ );  $t(8) = -2.443$ ,  $p = .040$ . PSTs were challenged during Student-Student Interaction due to the "behavioral" level of discipline we requested for the PSTs in the simulation (a level 3 typical of "urban" classrooms). Most of the PSTs did well despite this challenge. There was a significant difference in Student to Instructor Interaction between Time 1 ( $M=9.00$ ,  $SD=3.16$ ) and Time 2 ( $M=10.56$ ,  $SD=3.17$ );  $t(8) = -2.490$ ,  $p = .038$ . Specifically, the results suggest that PSTs' Student-to-Instructor Interaction was a key strength of candidates. This was largely due to PSTs' affect. The affective domain includes a host of constructs, such as attitudes, values, beliefs, opinions, interests, and motivation. There was not a significant difference in LDI and PCK between Time 1 and Time 2. Table 2 presents the significant findings from the paired-samples *t*-test.

A paired-samples *t*-test was conducted to compare overall RTOP scores at Time 1 and Time 2. There was a significant difference in the RTOP scores between Time 1 ( $M=41.78$ ,  $SD=13.19$ ) and Time 2 ( $M=47.56$ ,  $SD=13.95$ );  $t(5)=-2.550$ ,  $p = .034$ . These results suggest that TeachLive rehearsals, as part of an overall lesson study, may offer a venue for improving PSTs' teaching performance. Table 2 presents the results from the paired-samples *t*-test.

**Table 2: Paired-Samples *t*-test Results**

		Mean Difference	T	df	Sig. (2-tailed)
Pair2	PPK1 - PPK2	-1.44	-2.600	8	.032
Pair4	SSI1 - SSI2	-1.11	-2.443	8	.040
Pair5	SII1 - SII2	-1.44	-2.490	8	.038
Pair6	RTOP1- RTOP2	-5.76	-2.550	8	.034

### Powerful Mathematical Affect: Evidence from Rehearsals

Rehearse teaching proved to be a turning point for many prospective teachers. Data collected from PSTs' journal reflections indicate that the positive affective experience of their first *TeachLivE*<sup>TM</sup> rehearsal boosted their belief with regards to their ability to learn lesson planning and teaching mathematics. Some of the ES were characterized by belief systems, such as self-efficacy and self-identity while others were characterized by behaviors oriented toward fulfilling emotions. PSTs' meta-affect and affective pathways were also "strands" that helped unpack the emotions and behaviors in each ES, particularly with regards to understanding "the sequence of emotional states interact[ing] with heuristics during [lesson planning and rehearsing]" (Goldin, 2000). These emotions served as "AHA" moments signaling to the PSTs' belief that they can in fact teach a lesson on fractions (Liljedahl, 2005).

One of the most prominent engagement structures observed in PSTs' *TeachLivE*<sup>TM</sup> rehearsal was *Get the Job Done*. This structure was exhibited in their focus to persevere through an explanation and in their efforts to be comprehensive in their planning. This persistence may be in deference (a meta-affect) to instructions that required a 15-minute rehearsal; instructions they felt obligated to comply. As one PST reflects, "*The only thing I got out of teach live was the fact that you can never have too much. You should plan for a lot and try your best to get through it all. Have a multitude of questions prepared for all kids who may or may not be engaged.*" Similarly, another PST reflects, "*If I over complicated them (fractions) I might not be able to accomplish them,*" while another contends she needs to "*write out some of [the] key questions to make sure that [she] asks students everything [she] want them to think about.*" Indeed, the "motivating desire for task completion [was to] evokes more procedural, time-efficient strategies" (Goldin et al, 2011; p. 552).

Unsurprising, PSTs also exhibited the ES *Let me teach you*, where they verbalized the lesson objectives by using "I" statements to demonstrate to the avatar students and their instructors their ability to teach math. For example, through a series of scaffolded questions, several PSTs exhibited their *motivating desire* (mastery-approach goal) was to help a confused student understand how to transform an improper fraction into a mixed fraction. In a similar way, PSTs exhibited the ES *Check this out*, which may be linked to PSTs' intrinsic motivation of meeting the challenge to provide clarity to difficult math problems. Thus, PSTs' *motivating desire* to obtain an *intrinsic reward* was observed when PSTs assessed CJ, an avatar who struggled the most during the lesson, or Maria, another avatar who appeared disengaged most of the time. Several PSTs demonstrated *external emotions* such as excitement and enthusiasm, which was evident in their tone of voice.

One of the most frequently observed ES in the data was *Stay out of Trouble*, where PSTs avoided interactions that may lead to distress. For example, one PST avoided feeling vulnerable in her inability to answer a question (performance-avoidance goal); perhaps this was due to her initial low self-concept. A second frequently observed ES was *Don't disrespect me*, which was illustrated in the way PSTs commanded respect in a no-nonsense tone and nonverbal cues that indicated their intolerance towards distractions that detracted from meeting their lesson objectives. For example, several PSTs began calling on student avatars randomly, thereby requiring the avatars to remain focused throughout the lesson. This ES was markedly evident even within rehearsals of short

duration and was characterized by PSTs displaying respect for everyone's dignity and by providing a "safe" space for students to ask mathematics questions without fear about belittlement. One PST reflected in a "self-talk" tone, "*Although I was able to shut all these [student distractions] down within the first few minutes, I heard that they were worse with some of my classmates. I see how important it is to incorporate tasks that really engage the students so you can have their undivided attention for the time that you have.*" It is noteworthy that PSTs with lower self-efficacy (as it pertains to the context of modeling operations with fractions) may be linked with two additional engagement structures including *Its Not Fair* and *Pseudo Engagement*. Regarding *Its Not Fair*, PSTs expressed disappointment in their journals over rehearsing with avatars as opposed to K-12 students in the field and described their frustration with *TeachLivE's™*, which limited their proximity to students. *Pseudo Engagement* was observed among PSTs who exhibited apathetic behavior during teaching and relief when teaching sequences ended. Unsurprising, the findings revealed that PSTs often exhibited the *Let me teach you* engagement structure along with the *Look how smart I am* and *Check this out* engagement structures. These ES tended to link to PSTs' higher self-efficacy, as evidenced by language in PSTs' journal reflections and higher MTEBI scores.

### Implication

Rehearse teaching in *TeachLivE™* proved to be a turning point for many prospective teachers as it allowed them an opportunity to practice teaching, which in turn improved their affect and confidence in teaching, in general, and in teaching mathematics, in particular. Further, their overall improved reformed-teaching mirrored the improved affective states as evidenced by the "in-the-moment" affective constellation in the engagement structures. Additionally, despite instances of less positive affective states, PSTs' RTOP scores did demonstrate a statistically significant increase in scores that nudged PSTs from active teaching to active learning between their two rehearsals. This paradox of instances of low affect but high teaching performance is intriguing and suggests that low affect does not always translate into poor teaching ability, just as less positive engagement structures for students does not necessarily translate into poor performance in mathematics (Goldin et al., 2011). This outcome is worthy of further research.

Rehearsals with feedback in a simulated learning environment also enabled prospective teachers to enact instruction in controlled settings and afforded university faculty opportunities to provide immediate feedback after rehearsals. These experiences helped prospective teachers transform learning into practice, which is especially important for prospective elementary teachers who experience low confidence in mathematics settings. It also provided a venue for university faculty to closely mentor students thereby overcoming some of the constraints imposed by live classroom rehearsals. This study's results suggest that simulations may prove to be viable alternatives for rehearse teaching in clinical settings where optimal conditions cannot be secured. Simulations may also provide candidates with early mentoring opportunities that build self-confidence while also reducing the burden of placements on already taxed schools. With optimal clinical settings at a premium in rural, urban and suburban school districts, alternative modes for rehearse teaching need further investigation.

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