Assessing the Development of Professionalism in Teacher Candidates Through Mixed Reality

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ABSTRACT

Teacher preparation programs face persistent challenges in providing preservice candidates with sufficient, authentic opportunities to develop and assess non-instructional professional skills, particularly those outlined in Charlotte Danielson's Framework for Effective Teaching, Domain 4 (Professional Responsibilities). This study investigates the impact of a custom-designed Mixed Reality Scenario (MRS), *Collaborating as a Member of a Multidisciplinary Team* (MDT), on special education teacher candidates' perceived and actual development of these professional competencies. Drawing on a mixed-methods approach, initial qualitative data established the scenario's perceived authenticity and value, while subsequent quantitative analysis compared the self-efficacy of in-program students and recent graduates across treatment (MRS participation) and non-treatment groups using a 7-point Likert survey aligned to six components of Domain 4. While inferential statistical significance was not found, the analysis revealed medium to large effect sizes (Cohen's $d = 0.51$ to 1.21) among preservice teachers who participated in the MRS for skills related to Documenting Student Progress, Engaging Families and Communities, and Acting in Service of Students. These findings suggest that MRS can serve as a powerful tool to close the theory-to-practice gap, providing authentic experiential learning that cultivates professional skills typically developed only after entering the profession.

Keywords: Mixed reality, Human and artificial intelligence, Danielson framework for effective teaching, Assessment

INTRODUCTION AND BACKGROUND

The evaluation of teacher effectiveness and readiness across Prekindergarten through Grade 12 (PK-12) education is frequently guided by Charlotte Danielson's Framework for Effective Teaching (Danielson, 2022). This research-based framework segments effective teaching into four domains: Planning and Preparation, Classroom Environment, Instruction, and Professional Responsibilities (Domain 4). While proficiency in the first three domains—which govern direct instruction and classroom management—is readily observable and assessable during clinical placements, the skills related to Domain 4 often present a significant challenge for teacher preparation programs (Danielson, 2015).

Domain Four encompasses six key components that do not typically occur during direct student-teacher interaction: Reflecting on Teaching,

Maintaining Accurate Records, Communicating with Families, Participating in a Professional Community, Growing and Developing Professionally, and Showing Professionalism. Historically, many of these skills were assumed to emerge and develop only once the teacher transitioned into professional practice (Hong, 2018). This presents a critical gap, as limited professional experiences result in a marked response difference between preservice or early service teachers and veteran educators (Hong, 2018).

Mixed Reality Scenarios in Teacher Preparation

In recent years, Mixed Reality Simulations (MRS) have emerged as an innovative educational technology designed to address this experiential gap (Dieker et al., 2014; Dieker et al., 2016). MRS platforms, such as Mursion™ or TeachLivE™, marry human and artificial intelligence to create live, interactive virtual environments featuring diverse avatars representing students, colleagues, or family members. These scenarios provide responsive, authentic learning opportunities, allowing teacher candidates to practice discrete and complex skills in a safe, low-stakes environment with real-time coaching and peer observation (Hayes et al., 2013). Research has previously evidenced the effectiveness of MRS in developing discrete skills such as classroom management and instructional strategies (Regalla et al., 2016; Vince Garland et al., 2016).

In response to departmental data indicating special education majors lacked sufficient experience participating in or facilitating Individualized Education Program (IEP) meetings, a custom MRS was developed: *Collaborating as a Member of a Multidisciplinary Team* (MDT). In this scenario, special education majors facilitate a virtual IEP meeting for a fictitious student, working with an avatar regular education teacher, a speech-language pathologist, and the student's parent to collaboratively establish annual goals and Specially Designed Instruction. This scenario was purposefully designed to target the development and assessment of the professional responsibilities outlined in Danielson's Fourth Domain, which are intrinsically linked to the interprofessional collaboration and documentation required during an IEP meeting.

The use of this custom MRS transforms the clinical education experience by providing authentic learning opportunities that are otherwise inaccessible due to the unpredictable nature or lack of availability of traditional PK-12 clinical placements. Prior research established the alignment between participation in this scenario and the skills encompassed within Danielson's Fourth Domain (Duffy & Yeager, 2024).

This article presents a follow-up study that moves beyond scenario-alignment and student perception to quantitatively assess the actual impact of MRS participation (the treatment) on preservice teachers' self-efficacy across Domain four competencies compared to non-treatment groups.

METHODOLOGY

The study employed a two-phase, mixed-methods approach to investigate the efficacy of the custom MRS.

Phase 1: Scenario Alignment and Initial Perception (Duffy & Yeager, 2024)

Initial methodology involved the authors cross-walking the six components of Danielson's Domain 4 with the specific activities required of the teacher candidate while facilitating the virtual IEP meeting. This process established a clear link between the scenario and the target skills, such as accurately interpreting progress monitoring data (4B. Maintaining Accurate Records) and engaging family members in instructional decisions (4C. Communicating with Families). Preservice special education teachers participating in the sophomore-level course, *IEP: Process and Procedure*, completed the MRS as a one-to-one remote session. An initial anonymous student perception survey administered to this cohort revealed overwhelmingly positive quantitative and qualitative feedback, with 93% of students considering the experience worthwhile and 87% finding the simulation authentic and relevant to future practice.

Phase 2: Comparative Quantitative Analysis

To assess the impact of the treatment (MRS participation) on self-efficacy, a more rigorous quantitative survey instrument and comparison model was implemented.

Participants

The survey was administered via Survey Monkey to two primary groups within the Teacher Education Department (TED) at a small, private university: (1) In-Program Students (preservice teachers) and (2) Recent TED Graduates (early-service teachers). Within these two major groups, participants were categorized into Treatment (those who had completed the custom IEP MRS) and No-Treatment (those who had not completed the custom IEP MRS).

Instrument

A ten-item survey was developed to serve as indicators for the six target components of Danielson's Fourth Domain. Items were refined through an iterative process involving the original researchers to ensure high content validity and clarity. A 7-point Likert scale was used for responses, where 1 represented 'Strongly Disagree' and 7 represented 'Strongly Agree'.

Procedure and Analysis

The survey was open for a nine-day period. Outcomes were aggregated by major groups (In-Program vs. Graduate) and by program status (Treatment vs. No-Treatment). Statistical analysis was completed using SPSS 28.0.

Descriptive statistics (means) were calculated for each survey item across the four comparison groups. To determine if the treatment (participation in the scenario) increased the self-reported development of skills related to Principled Teaching, two statistical measures were used:

- Inferential Testing: Independent Samples Mann-Whitney *U* Tests were conducted to compare mean differences.
- Effect Size (Cohen's *d*): Cohen's *d* was calculated to determine the practical significance of the difference in means between the Treatment and No-Treatment groups, using the pooled standard deviation. Cohen suggests an effect size of $d = 0.2$ is small, $d = 0.5$ is medium, and $d = 0.8$ is large. Effect size was used as the primary measure of impact, particularly in the social sciences and when statistical significance is not present.

FINDINGS

The inferential statistical analysis using the Mann-Whitney *U* Tests found no statistically significant difference in means between the Treatment and No-Treatment groups for either in-program students or recent graduates. This outcome necessitated a focus on effect size (Cohen's *d*) to assess the practical significance of the intervention.

Effect Size Results in Preservice Teachers (In-Program)

Among the preservice teachers surveyed, participation in the MRS yielded consistently positive effects compared to the no-treatment group, with the results clustered into small, medium, and large effect sizes (see Table 1 summary for details).

Specifically, four large effect sizes ($d \geq 0.80$) were observed for items aligned to the following components:

- 4B. Documenting Student Progress: Items related to maintaining detailed records and using student learning trajectory information ($d = 1.14$ and $d = 1.21$).
- 4C. Engaging Families and Communities: Item related to working with families and guardians to support student success ($d = 1.14$).
- 4F. Acting in Service of Students: Item related to feeling confident making educational choices in the best interest of students and their families ($d = 1.11$).

Five medium effect sizes ($0.50 \leq d < 0.80$) were observed for items aligned to:

- 4A. Engaging in Reflective Practice: Item related to self-assessment of teaching practices ($d = 0.61$).
- 4D. Contributing to School Community and Culture: Item related to comfort with collaboration and teamwork ($d = 0.51$).
- 4E. Growing and Developing Professionally: Item related to seeking feedback from colleagues ($d = 0.59$).
- 4F. Acting in Service of Students: Item related to interacting with parents/colleagues with care, honesty, and integrity ($d = 0.56$).
- 4C. Engaging Families and Communities: Item related to trying to include all parents/guardians ($d = 0.73$).

Only one small effect size ($d = 0.2$) was observed for an item related to 4A. Reflective Practice.

Effect Size Results in Recent Graduates

Among recent graduates, participation in the MRS resulted in smaller effects, reinforcing the premise that skills in Domain 4 are significantly developed during professional practice.

- Only one medium effect size ($d = 0.60$) was observed, related to **4F. Acting in Service of Students** (feeling confident making educational choices).
- All other survey items demonstrated small effect sizes ($d \leq 0.40$), including zero effect size for the item on using student learning trajectory (4B).

Table 1: Summary of Cohen's *d* effect sizes for MRS treatment vs. no-treatment groups.

Domain 4 Component	Effect Size (d) – In-Program (Preservice)	Effect Size (d) – Graduates (Early-Service)
4A. Reflective Practice	Medium (0.61)	Small (0.10)
4B. Maintaining Accurate Records	Large (1.21)	Small (0.40)
4C. Engaging Families/ Communities	Large (1.14)	Small (0.40)
4D. Professional Community	Medium (0.51)	Small (0.20)
4E. Professional Growth	Medium (0.59)	Small (0.30)
4F. Showing Professionalism	Large (1.11)	Medium (0.60)

DISCUSSION

The primary objective of this study was to assess the impact of a custom MRS on the development of professional competencies in preservice teachers. The findings strongly suggest that while the experience does not yet translate to a statistically significant difference in self-efficacy, it produces a meaningful practical impact that is highly relevant to teacher preparation.

The presence of medium and large effect sizes among preservice teachers, particularly across components 4B, 4C, and 4F, indicates that the MRS is highly effective in developing self-efficacy in skills that are historically difficult to practice and assess prior to employment. The largest effects were observed for skills that are central to the IEP scenario:

- 4B (Documenting Student Progress): The scenario inherently requires candidates to interpret and use student data (RR) to inform goal-setting, providing the necessary context to feel confident in this area.
- 4C (Engaging Families and Communities): Facilitating the virtual meeting necessitates communication and collaboration with an avatar parent, directly addressing this component in an authentic manner.
- 4F (Acting in Service of Students): The complexity of the MDT collaboration compels the candidate to advocate for the student and make educationally sound decisions, leading to a large effect on reported confidence.

The distinct difference in effect size between the in-program (preservice) treatment group (large effects) and the graduate treatment group (mostly small effects) reinforces the findings of Hong (2018). Crucially, the medium and large effects noted in preservice teachers suggest that the use of this custom MRS can successfully close the practice gap by providing authentic and experiential learning opportunities to develop skills within Danielson's Domain 4 *before* they encounter these situations in their own classrooms. This finding aligns with and extends previous research suggesting that teacher training programs can be improved through the practical, experiential learning opportunities an MRS provides (Bosch & Trevo, 2021).

By leveraging the functionality of MRS to create an otherwise inaccessible experience like the IEP meeting, teacher preparation is redefined. This intervention affords candidates the opportunity to synthesize prior knowledge, apply effective communication strategies, and practice professional responsibilities in a context-rich, consequence-free environment.

Conclusion and Recommendations

This study provides compelling evidence that Mixed Reality Scenarios offer practical significance in developing the professional competencies of preservice teachers. By providing an authentic context for interprofessional collaboration and family engagement, the custom MRS effectively fostered self-efficacy in Danielson's Fourth Domain, particularly in the areas of student data documentation, family communication, and professional decision-making.

Further research should focus on two key areas: (1) extending the study to use performance-based observation to assess skill transfer (beyond self-efficacy) following MRS participation, and (2) investigating the sustained impact of MRS on the long-term professional success and retention of early-service teachers. The authors strongly recommend that teacher preparation programs consider incorporating custom MRS to develop and assess professional skills that remain inaccessible or unpredictable in traditional clinical settings.

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