

ONLINE TEACHER EDUCATION: EXPLORING THE IMPACT OF A READING AND LITERACY PROGRAM ON STUDENT LEARNING

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ABSTRACT

This study presents findings from an investigation of the impact of teachers who graduated from a fully online master's degree program with training in pedagogy and a content-specialization in elementary reading and literacy (oERL) on reading achievement in a large urban public school system in the northwestern United States. The research team used a non-equivalent group design and matched pairs of teachers based on degree, grade-level taught, and teaching experience to construct the study on three years of student and teacher data. The study consisted of 70 teachers and 3,828 student observations. Hierarchical linear modeling was employed to understand the teachers' effects on student learning over time. Results indicate there was a significant positive effect of the oERL on student achievement. Broadly, this study is an example of a serious attempt to ascertain the impact of a high demand and fully online program on the community where graduates are employed. More narrowly, these results support the view that a fully online program aimed at training teachers can provide opportunities for those teachers to obtain the pedagogical content knowledge that can positively influence instructional effectiveness.

KEYWORDS

Teacher education, pedagogy, elementary reading and literacy (oERL), impact

I. INTRODUCTION

Local education agencies (LEAs) are expected under Federal, state, and local legislative and political pressure to address a multitude of community, regional, national, and even international needs, requirements, and concerns. Under the No Child Left Behind Act [1] which reauthorizes and expands the Elementary and Secondary Education Act (ESEA), LEA's are mandated to provide evidence that student achievement goals are met and that teachers are highly qualified; they are further required to respond to individual student needs under Individuals with Disabilities Education Act (IDEA-97) amendments of 1997 [2]. Additionally, NCLB requires that LEAs specify the degree student achievement goals are met by specific subgroups of students (e.g., race, English language learner status, special education status and social economic status).

Fully addressing these mandates is complex because it must be done while simultaneously addressing the educational needs of a student population that "is ethnically, linguistically, and socio-economically diverse" [3]. Moreover, the rapidly changing socio-economic landscape is bringing about an educational system that is more urban, diverse, and organizationally complex. For instance, ethnic minorities will

comprise the majority of students in U.S. public schools by 2035 [3]. In response, LEAs will need to recruit and retain a teacher workforce that can enhance or create new student engagement and instructional strategies to address the needs of both locally and internationally diverse second language learners [4]. Teachers, therefore, will require education and ongoing professional development that provides appropriate pedagogical content knowledge and proficiencies (technical, semantic, diagnostic) to meet the challenges of a 21st century classroom [5, 6].

To meet these LEA needs, teacher education programs must (a) recruit a diverse and competent cadre of teachers that can communicate and prepare socially, linguistically, and economically diverse students to compete in a global economy, (b) provide learning experiences that meet the unique certification, classroom preparation, and professional development needs of today's teacher, (c) provide appropriate delivery and participation options (face-face, online, etc.), and (d) address the growing demand for outcome data that shows how their graduates add value in terms of student performance on standardized academic achievement tests. However, they must also be able to meet these requirements within a heightened accountability framework that requires empirical evidence based on achievement test scores that supports a teacher's "value-added" to districts, while working with significantly diminished resources and uneven assessment capacity within institutions of higher education and LEAs to promote formative assessment at the system, district, and teacher levels [7]. Nonetheless, school districts and teacher educators are diligently working on strategies to address these requirements. To inform an urban university-district collaborative in their attempt to meet the aforementioned requirements, this article presents findings from an investigation into the effects on elementary school student reading achievement of teachers receiving masters degrees in a completely online advanced graduate teacher education program.

II. BACKGROUND

A. Online Instructional Strategies Aimed at Addressing the Diverse Educational Needs of Teachers

School districts and universities engaged in teacher education and professional development are grappling with how best to address cost, access, efficiency, and recruitment. Online education is viewed as one avenue for addressing these needs. As postsecondary institutions continue to adopt at a rapid pace the variety of communication and course delivery modes to support instruction and learning [8, 9, 10, 11], faculty and administrators are moving parts of classes and programs or sometimes the entire curriculum to online learning platforms [3, 12, 13, 14, 15, 16, 17, 18].

The move toward online delivery methods has recently extended to teacher education programs. Specifically, teacher educators are attempting to provide full or partial undergraduate, post baccalaureate, and graduate teacher education programs and course offerings [15, 17, 19, 20, 21], field experience and practicum support [19, 22, 23], and teacher professional development and enrichment opportunities [2, 24, 25, 26, 27, 28].

Creating scalable and nimble approaches to meet teacher education and professional development needs is especially salient given the continuing national growth in student enrollment, the attendant need to address the learning needs of diverse groups (ESL, special education), and demand for support services to educate, engage, connect, and encourage beginner and experienced teachers. Boroko, Whitcomb, and Liston [29], for example, find that professional teacher professional development programs are "increasingly turning to ... contemporary, innovative technologies as a way to reach large numbers of individuals at costs lower than those associated with the physical presence of professional development facilitators" [30, p. 5]. Dede, Ketelhut, Whitehouse, Breit, and McCloskey identify the need for

technology-supported teacher learning:

...that can fit with teachers' busy schedules, that draws on powerful resources often not available locally, and that can create an evolutionary path toward providing real-time, ongoing, work-embedded support has stimulated the creation of online teacher professional development (oTPD) programs [30, p. 9].

Despite the burgeoning literature about the impact of online instruction broadly and increasing demand for online education in general, and teacher education and professional development in particular, there are mixed findings about the efficacy of these modalities, particularly concerning effective participant engagement in learning experience, impact on teacher retention, and participant impact on subsequent pupil achievement [18, 31, 32]. For instance, in discussing online teacher professional development, Colgan, Higginson, and Sinclair [32, 33] declared "most of the research that deals with the topic of online professional development is limited to statements of vision, opinion, curriculum integration ideas, and description of putative benefits ascribed to web and other networks" [33, p. 315]. Almost ten years later, this statement was echoed in the *Journal of Teacher Education* following a review of nearly 400 articles about online, face-to-face, and hybrid teacher professional development programs when Dede and colleagues wrote that the "evidence of effectiveness is often lacking, anecdotal, or based on participant surveys completed immediately after the professional development experience" [30, p. 9]. They found that only 10% met a quality threshold that could be considered empirically sound research (They note criteria for assessment is described in Whitehouse, Breit, McCloskey, Ketelhut, & Dede [34]). The 2009 study categorized the collected studies around research themes: program design (evaluation of content, pedagogical approach, methods of delivery, and best practice); program effectiveness (participant self-reported satisfaction and short-term categorical change outcomes); program technical design (effect of communication and multimedia on collaboration and building a learning community); and learner interactions (quality of participation and efficacy of online communication and collaboration). Of the 40 studies established as high quality, only a study by Fishman, Marx, Best, and Tal [35] was reported to have rigorously examined the relationship between student outcomes and the goals of an online teacher professional development program. More recent studies are beginning to show evidence of positive student learning and engagement outcomes associated with online programs, including. For instance, the large scale National Survey of Student Engagement report declares that "course management and interactive technologies were positively related to student engagement, self-reported learning outcomes, and deep approaches to learning" [36, p. 20]. Additionally, these modalities are thought to have a positive and significant role in promoting student-faculty interaction and personal and social development.

B. Approaches and Gaps in the Teacher Effects Research Literature

Teacher effects models are highly valued strategies for determining professional development and teacher education outcomes, but there is considerable controversy regarding the contributions of teacher background variables to student learning outcomes, and about the specific models used to conduct the analyses. Many educational researchers believe the teacher effects literature shows significant deficits in terms of coherent theoretical frameworks and sound empirical research findings. For instance, Palardy and Rumberger [37] highlight the McCaffrey, Lockwood, Koretz, and Hamilton [38, p. 113] RAND report denoting there is "little convincing evidence on the magnitude of a teacher effect or relative importance of an aspect of the teachers as a source of variability in student achievement." Palardy and Rumberger [37] also note that Federal legislation [1] has predominately defined highly qualified teachers in terms of background characteristics such as intelligence and aptitude tests, education level (e.g., bachelor's degree for elementary and secondary school teachers and subject matter expertise for secondary school teachers), state certification (excluding emergency, provisional, or temporary licenses), and other credentials. Palardy and Rumberger [37, p. 111] highlight several studies [39, 40, 41, 42, 43,

44, 45, 46, 47, 48, 49] to support the contention that background characteristics and their relationship to student learning is “ambiguous.” The researchers further state there is “little scientific evidence that these characteristics have a measureable and consistent direct impact on student achievement” [37, p. 112], but do contend there is evidence for indirect impacts. For instance, they note the recent Guarino, et al. [50] study of kindergarten students that exhibited a significant relationship of coursework in reading instruction methods that were positively associated with the use of reading practices deemed by many as advantageous for learning. The empirical results of the Palardy and Rumberger [37] study of first grade reading and math achievement, however, did ultimately find that reading gains were associated with certification, and they also note that many studies show positive relationships for one or more background characteristics. For instance, they note the Wayne and Youngs [48] meta-analysis of 21 studies that controlled for socio-economic status (SES) and students’ prior achievement and found evidence that “college ratings and test scores had consistently positive associations with achievement gains across grade levels and participants, there was less support in the literature for the effects of degrees, coursework, and certification...” [48, p. 113].

In our view, Palardy and Rumberger [37] correctly point out deficits in the research literature by questioning coding strategies, omitted variables such as attitudes and practices, and incomplete models. However, we contend a well designed research enterprise with a narrower scope can still significantly contribute to the extant research literature:

The usefulness of small, comparison group studies—as well as large correlational studies that use grosser measures – is not in the definiteness of their individual findings but in the contribution to a larger body of work from which evidence can be triangulated [39, p. 15].

Darling-Hammond, Holtzman, Galin, and Vasquez-Heilig [51] make a compelling case for considering the effects of teacher background characteristics on student learning gains, even in isolation from attitudes and practices if the empirical framework is limited and warrants this approach. For instance, the 2005 study looked at fourth and fifth grade student achievement gains for six reading and mathematics tests in the Houston public schools over a six-year period for Teach for America. The study considered full certification (professional or standard certifications) to be a proxy for a defined set of courses that mapped to a test of core academic skills, specialized subject matter, and pedagogical knowledge, a reasonable assumption under Texas Administrative Codes (Title 19, Part 7, Rule 230.191, 2004). Specifically, they highlight it is reasonable to surmise that a teacher with traditional certification has “the ability to manage a classroom, design and implement instruction, and work skillfully with students, parents, and other professionals” [51, p. 22]. The findings indicate that these types of teachers were indeed significantly more effective than other teachers in prompting student achievement gains on three of the six measures over the period. There was no instance in the study where a certified teacher influenced gain scores less than an uncertified teacher and on five of six tests the uncertified teachers had significant negative gains (and one non-significant negative gain). The alternative route teachers had non-significant negative gains on five of the six tests.

In many respects, the Darling-Hammond [39] study underpins the research work reported herein by providing a methodological framework for conceptualizing teacher effects and supporting the idea that this type of research should inform the work of states, school districts, and teacher educators who need to develop and expand the reach of academically sound and efficient preparation routes and understand their “value-added”. They contend, as we do, the critical need to identify, support, and retain quality urban teacher education programs that “have strong records of preparing capable teachers who stay in the city schools” [39, p. 23].

C. Constructing an Online Elementary Reading and Literacy Program (oERL) for Teachers

Online teacher education and professional development curricula have suffered from a lack of consistent and coherent connections between the specific domains of competence (e.g., reading, math, etc.), pedagogy, and student learning and cognition in online teacher education and teacher professional development curriculum [52, 53, 54] as cited by McCrory, Putnam, & Jansen [20]. Teacher education more often than not focuses more on generic pedagogy (e.g., constructivist learning frameworks) than on the steps a teacher needs to take to effectively integrate pedagogy with disciplinary knowledge in reading, math, or science. These “essential tensions” between improving teacher professional practice and “intellectual development in the matters of school curriculum” is a persistent dilemma in teacher education and professional development programs [52, p. 951] as cited by McCrory, Putnam, & Jansen [20]. McCrory, et al. [20] claim these programs are not adequately allocating attention toward the facilitation of a teachers’ ongoing growth in intellectual competence relative to a subject area. Supporting this claim, Schrader and colleagues [56] also cited the research of Kinzer, Labbo, Leu, and Teale [57] to highlight findings from reading teacher self-reports that contend they are lacking exposure relative to progressive literacy teacher education and practices. For instance, teachers reported receiving very little time focused on reading pedagogy and few reported having mentors or established teachers demonstrating effective practices. Moreover, there was a general view that the instructional contexts of teachers at that time did not appear to reflect attributes of an authentic problem solving context.

To address these deficits, the online Elementary Reading and Literacy (ERL) program studied herein designed the curriculum and program to focus on two key outcomes: (1) enabling the educator to become an “expert” decision maker in the field of reading and literature instruction so s/he may effectively address the diverse abilities, socioeconomic, and ethnic backgrounds of children [56, p. 318] citing the 1998 National Research Council’s Committee on the Prevention of Reading Difficulties in Young Children), and (2) fostering the scholar-practitioner in all teachers, learning research-based literacy theories and strategies, performing research as part of the curriculum, and implementing the findings and reflecting on their practice. The curriculum in place at the time of the study was also designed to meet the standards of the International Reading Association [58]. Drawn from professional expertise and research, the IRA standards identify what teachers need to know and be able to do in order to be competent literacy educators. The oERL program is based on current research and practical, research-based classroom strategies to increase the achievement and oral reading fluency of all their students, including linguistically, culturally, and academically diverse learners. The program subsequently revised its curriculum based on the International Reading Association standards [59], designed to identify the knowledge and skills teachers need to confidently manage their classroom literacy programs and to effectively address the complexities of teaching reading and writing in today’s classroom. Additional consideration was also given to the National Reading Panel’s report [60] on the scientific evidence of various approaches to teaching children to read.

The IRA aligned curriculum is delivered within a program structure that combines online course delivery and communication, face-to-face interaction with their peers, and optional enrollment in strictly online classes. Some oERL students, such as those in this study, attend the university in cohorts where the university works to keep them in courses together throughout their program of study. This gives students a sense of the cohort community within the university, enabling cohort members to share and collaborate on assignments, course materials, and instructional strategies outside the graduate classroom. During the study, the program offered an optional hybrid model, a blended environment where cohorts of students from the same schools or districts worked together in person, face-to-face, to conduct course-based research and discussions. While the students worked face-to-face, their instructors were at a distance. Student to instructor communication and assessments was done weekly or more often through email and

telephone. The hybrid model was similar to those studied by Bourne, et.al. [61], who found that “The studies on blending, combining face-to-face and online methods for learning, offer rich possibilities for what many see as the best of both learning modes” [61, p. 9]. Although the program became 100% online by 2006, some study participants continued to work together in the online classrooms. They enrolled in the same classes, collaborated on developing and implementing classroom strategies, and wrote assignments together. This approach to online education, though no longer as unique today as during the study, encourages students to share their learning with their own students, colleagues, schools, districts, and communities.

Two additional program features warrant mention. First, oERL students have access to an extensive electronic university library, as well as additional online media related to their course requirements such as Wiki's, podcasts, etc. Students also have access to media and materials outside of their particular courses. The library creates a sense of engagement within and outside the classroom. Students use these media in their own schools and classrooms. Second, intensive Discussion-Board participation is a required element in every course and serves as a foundation for building the scholar-practitioner community. Students' postings must include critical analysis of course materials. Responses to colleagues are not just "chat", but are evidence-based discussions of colleagues' postings, fostering a collegial sharing of ideas and practices. Each element builds the scholar-practitioner community as students learn about one another, help each other in professional development, and understand others' similar experiences. Students in the program teach different grade levels, in different schools and districts throughout the United States and globally; through the program they share their research-based strategies, ideas, and reflections on course materials and strategies, broadening their experience and deepening their understanding.

The oERL's early adoption of a fully online program model presents a unique opportunity to study the effects of online teacher education. At the time of the study, fully online delivery was much less common than it is at present, and the program considered this a significant aspect of its methodology. Drawing heavily from the work of Bruce [62] and Grisham and Wolsey [63], the International Reading Association [64] position paper entitled “New Literacies and 21st Century Technologies” challenges graduate teacher education programs and school leaders engaged in professional education to infuse the curriculum with the use of technology to “motivate students, bridge the gap between students' social and academic uses of technology, and, in many cases, provide access to technology for their students” (64, p. 3). Unfortunately, the paper also finds that research in the area of literacy and technology integration is only now emerging. For instance, the paper highlights the recent work of Coiro et al. [65] as significant, but notes the “paucity” in evidenced-based approaches and research (65, p. 3). Given the state of the field at present, the curriculum of the oERL, and its mode of delivery, the opportunity to review teacher effects on achievement for a completely online teacher education program is truly unique.

III. METHODOLOGY

A. Data Sources and Sampling Strategy

The data for the sample was obtained from three main sources: an urban public school district in the northwestern United States, the oERL, and Market Data Retrieval (MDR) an education data vendor. First, the majority of teacher and student data was provided by the district using standard fields from their district data warehouse under a formal Agreement for Conducting District-Approved Research. The research team used existing district assessment and teacher data to construct the dataset used for analysis. The LEA approved this low-impact approach, but would not allow classroom observations, teacher surveys, or additional data gathering due to teacher time considerations. The district-provided data included student demographics, teacher demographics, student assessment performance on multiple measures from 2004 to 2008, and some teacher experience and education information. The second data

source was the partner university, which provided directory information on oERL graduates. Third, MDR, a third party information vendor, provided information on degrees earned by TPS teachers.

To identify teachers who graduated from the oERL program, we identified all teachers by grade-level who worked in the school district from 2006 to 2008 and who graduated from the oERL program before the fall of 2007. District records were then used to link the teachers to their students in each of the three years of data. To establish the comparison group, we matched each oERL graduate to a non-oERL teacher in the district who earned a master's degree, worked in the same grade, and had similar levels of teaching experience. When possible, we matched teachers within schools in order to balance the effect of school-level factors on student outcomes. This procedure was done separately in each of the three years. Teacher attrition and teacher transfers between grades and schools made it impossible to sustain the initial teacher matches over three years.

The purpose of this matching effort was to eliminate, to the extent possible, unobserved differences between teachers that may influence their respective students' performance independent of their actual teaching ability. By matching teachers within the same grade and school, we sought to balance many of these external contextual factors that have an independent effect on student achievement or teacher performance. For example, we may presume that teachers in the same school and grade are participating in similar professional learning activities, receiving similar levels of administration support, and dealing with similar students and parents. By balancing these factors across our comparison groups of teachers, we allow more confidence that differences in student achievement between the groups reflect systematic differences in teachers' instructional effectiveness rather than differences in other factors.

The decision to restrict the pool of available matches to teachers with existing master's degrees was also aimed at eliminating unobserved differences between the oERL teachers and their comparison group. Although there is strong evidence that students receiving instruction from teachers educated at competitive undergraduate institutions have higher levels of achievement than students with less qualified teachers [66], the extant literature shows there is very mixed to negative evidence that advanced degrees make teachers more effective in the classroom [43, 66, 67, 68]. Nevertheless, teachers who pursue master's degrees may share similar characteristics that may influence their effectiveness independently of what they actually learn in the degree program. For example, they may have a similar commitment to the teaching profession, which also may influence their professional development activities and work habits. By restricting the comparison group to only those teachers with master's degrees, the intention is to balance some of those unobserved shared traits and thus more effectively isolate the impact of the online program vs. other programs. Given that the average elementary school in our sample had between three and four teachers in a grade, we were unable to match each oERL teacher to a comparison group teacher in the same school who also held a master's degree. Consequently, we had to match across schools in this manner for 36% of our sample.

B. Sample Characteristics

The final sample using the matching strategies outlined above consisted of 31 teachers who graduated from the oERL and were teaching in grades one through five in the school district from 2005 to 2008, and 39 similar TPS teachers. There were a total of 57 oERL graduates employed that worked in the district from 2005 to 2008. However, the final sample includes 31 teachers because (a) we were unable to properly match teacher credential data or (b) others the teachers were working in the upper-grades (middle school or high school). Sixteen of the teachers were matched to comparison group teachers who were in the same school; the remaining teachers did not have master's degree teachers in the same grade level, and were therefore matched to teachers in different schools who held master's degrees. The match was conducted separately within each school year in order to account for teacher attrition and grade level

transfers resulting in teachers who were present for less than the full three years of the study. This means that the total number of comparison group teachers is 39, while only 31 comparison group teachers were used within each study year. Data on the comparison group teachers' master's degrees were limited to a Yes/No indicator of whether they earned a degree. No data were available on the type of degree or the name of the degree-granting institution. This essentially makes the study a test of the average effect of earning an oERL degree from the university partner relative to the average effect of earning a master's degree from other postsecondary institutions.

The oERL teacher characteristics were substantially similar to those of the matched comparison group teachers. There was the same proportion (and number) of female teachers (83%) and master's degrees held (100%). The groups also had similar experience levels, although the samples are not perfectly balanced because after restricting the possible matches for each oERL teacher to the non-oERL teachers in the same grade who held master's degrees, it was not always possible to find a teacher with exactly the same level of experience. The oERL teachers in general had less experience than the comparison group teachers with 8% having 3-5 years (comparison group=6%), 26% having 6-10 years (comparison group=11%), and 66% having over 20 years (comparison group=82%).

Table 1: Characteristics in the school district study student sample

Ethnicity	oERL	Comparison Group	Difference	Significance
% Black	11%	11%	0	
% Hispanic	24%	19%	5	*
% Asian	13%	11%	2	
% White	35%	43%	-8	*
% ESL	7%	4%	3	
% Sp. Ed.	9%	10%	-1	
Student Obs.	1834	1994	-160	

* p<.10, **p<.05, p<.01

The oERL graduates in the study were linked to a total of 1,774 student observations of DIBELS fall to spring gains for the sample period. These student observations were compared to 1,740 observations of the matched teachers. Table 1 displays the characteristics of these students. It reveals that oERL teachers served a higher proportion of minority students than the matched comparison group teachers. The differences in the proportion of black students and white students in the oERL and comparison groups were statistically significant, whereas the other observed differences were not.

IV. OUTCOME

The study used a measure of oral reading fluency administered by the district in fall and spring of the academic year—the Dynamic Indicators of Basic Early Literacy Skills (DIBELS). DIBELS consists of seven short measures of student literacy that are administered individually to students by the teacher. Teachers are provided prescribed protocols for administering and scoring the measures so that the measures and scores are comparable for all students across grades and over time.

This study focused on the results of one DIBELS measure that is given to all students in 1st through 5th grade: the DIBELS Oral Reading Fluency Measure (ORF). The ORF is designed to monitor students' ability to read aloud fluently. Students are given a short passage that has been calibrated to measure if they are meeting their benchmark goals for reading at grade level. They are asked to read the passage aloud for one minute. The teacher then scores the students based on the number of correct words per minute that they were able to read [69, 70, 71]. The ORF is administered in conjunction with the DIBELS retell fluency measure (RTF). The RTF is designed as a comprehension check on the ORF. After

students finish the ORF measure, they are asked to retell as many words from the ORF passage as they can within one minute. According to the DIBELS creators, the general rule of thumb is that the ORF score is a strong overall indication of reading comprehension if the retell score is at least 25% of the oral reading fluency score. For example, if a student reads 60 words correctly in one minute and is able to use at least 15 words to retell the passage, then the ORF is a reliable measure of his/her overall reading comprehension skills. We examined the ratio of the RTF to the ORF and found that at all grade-levels, the ratio was above 25 percent for oERL students and non-oERL students.

Table 2: Ratio of Average Spring RTF Score to Average Spring ORF Score for oERL Sample

	ORF Score	RTF Score	Ratio
Grade 1	62.7	25.1	40.1%
Grade 2	103.5	49.3	47.6%
Grade 3	106.1	39.2	37.0%
Grade 4	121.8	53.6	44.0%
Grade 5	136.6	53.6	39.2%

This measure was chosen because it was the best district measure available pre-post for all grades of interest that is related to the program of interest, and it was the principle district-selected reading measure for the primary grades. One advantage of using the DIBELS ORF is that the district administers the test three times each year: once in the fall, once in the winter, and once in the spring. This allowed the researchers to calculate the growth in oral reading fluency that students make during the school year as the difference between a student’s fall test score and spring test score, rather than relying on spring-to-spring results as is required when using state assessments.

There is substantial empirical evidence to suggest that oral reading fluency is a reliable measure of students’ overall reading competence, the most salient characteristic of skillful reading [72, 73, 74]. Fuchs, et al. [75] found that oral reading fluency is more highly correlated with performance on standardized tests of reading comprehension than more direct measures of reading comprehension. The specific DIBELS Oral Reading Fluency measure (ORF) has also been shown to have a moderate to strong association with state standardized reading assessments [70, 76, 77, 78, 79, 80]. In a study within an urban school district, Riedel [81] found that first grade students’ DIBELS ORF subscale score was the strongest predictor of all subscales of reading comprehension gains in first grade. A recent study by Roehrig et al. [82] also found moderate correlations between third grade students’ ORF scores and reading comprehension scores on the FcaT-SS and SaT-10. However, the study also recognizes that there is significant debate about the merits of this measure in terms of its relationship to reading comprehension as a proxy assessment and its specific assessment approach [83]. In other words, are the dimensions of reading measured on the DIBELS such as phonological awareness, alphabetic principle, accuracy and fluency with connected text the right dimensions to measure and in which subgroups are they most relevant?

A. Analytic Strategy

Because sample and variable selection were dictated by available data, we could not fully implement the suggested multilevel theoretical framework (e.g., school, teacher-classroom, and student levels) for reviewing the variation in “student achievement gains” [37, p. 117]. We therefore employed a multilevel model that used fixed school effects and estimated teacher effects. Palardy and Rumberger [37] note that assignment at the classroom level is at least reasonable when undertaking a teacher effects analysis because: (a) estimating at only the school level can result in aggregation bias and other statistical issues and (b) omitting school level variables in a teacher effects analysis is not apt to confound results. In Figure 1, we provide a conceptual outline of the relationship of the measures associated with each level

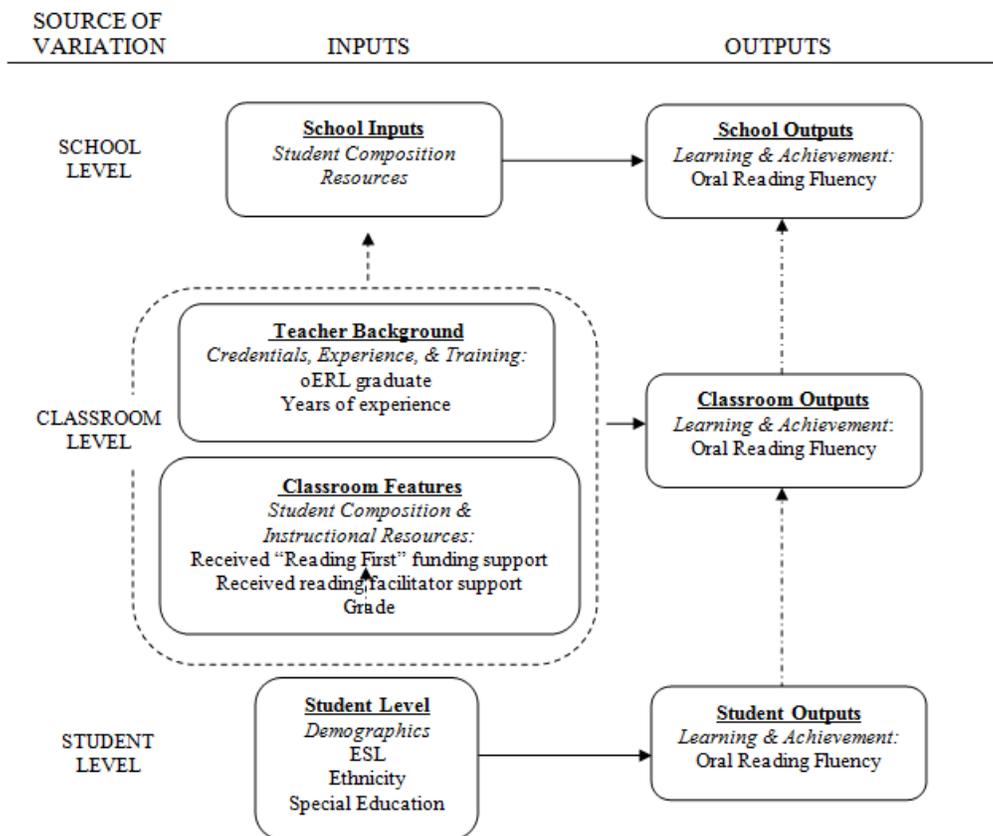
and stage. Please note that the solid arrows indicate a potential cause and effect relationship and the dotted arrow indicates an association due to aggregation of a measurement (e.g., mean ORF gains).

B. Statistical Model

To compare the oERL program to the matched comparison group, we pursued a residual gain score model for fall to spring gains in Oral Reading Fluency on the DIBELS. Specifically, we used a difference score outcome for measuring change between the two repeated measures. The initial oral reading fluency score was used as a covariate. The difference between the variance and coefficients for this approach in comparison to a repeated growth model approach is negligible except for the magnitude of the intercept coefficient for the residual gain score approach. However, by adding prior achievement as a covariate at student-level, the outcomes have become similar [37].

Consistent with Figure 1, our modeling approach took into account the hierarchical structure of the data and allowed us to examine the factors that affect student achievement and understand the association between the student and teacher achievement gains. Although our focus was on estimating teacher-level effects, we included the school fixed effects to (a) allow for the nesting of teachers within schools, (b) to restrict our comparisons to variation within schools, and (c) to account for the fact that we could not balance the samples such that each oERL teacher had a match within the same school in every case.

Figure 1: The Relationship of Student Reading Achievement to Student and Teacher Factors



Source: The conceptual diagram was adapted from a figure entitled “a multilevel theoretical framework of classroom and school effects” found in Palardy & Rumberger [37].

This was a school-level fixed effects model that examined the factors that affect student achievement at both the student and teacher levels [84]. The model controlled for student characteristics (ethnicity, English as a Second Language status, and Special Education status) to avoid falsely ascribing a difference in average gains between oERL and non-oERL teachers to the university's program, when they are due to differences in the characteristics of students the teachers serve. Additionally, an indicator for whether or not the teacher is working in a Reading First school was included to account for the supplemental reading instruction that accompanies the Reading First funds from Title II. Also, an indicator of whether the teacher is working in a school that has a full-time reading instruction facilitator was included to ensure that the effect of the oERL teachers was not confounded by the effect of the instructional facilitators. The model also included grade effects to control for differences in gains that are due to differences in the distribution of students in grades one through five between the samples and year effects to control for differences in achievement that are constant across all students in the sample, but vary over time.

To understand the effectiveness of the oERL and their matched counterparts, we estimated our model with three years of student level data using clustered standard errors to account for the nesting of teachers and students within classrooms and schools. The mathematical details of the model follow:

$$Y_{it} = \beta_0 + \alpha X_{it} + \lambda \bar{X}_{it}^c + \eta \bar{X}_{it}^s + \delta_g D_{it} + \theta T_{it} + \pi_{st} + \gamma_g + \nu_t + \varepsilon_i$$

Where:

Y_{it} = Spring Oral Reading Fluency score of student i in year t .

X_{it} = Vector of student level characteristics, including demographic/special program indicators (Black, Hispanic, English as a Second Language and Special Education status) and the fall Oral Reading Fluency (ORF) score of student i . The fall pre-test allows us to measure the achievement during an entire school year (fall to spring). \bar{X}_{it}^c is a vector of the average student characteristics in the classroom of student i at time t ; \bar{X}_{it}^s is a vector of the average student characteristics in the school of student i at time t . The coefficients of X at all levels (student, class, and school) were held constant across grades and years. Student characteristics were included to account for the fact that students are not randomly assigned to teachers and consequently differences in the average performance within a classroom is not assumed to be exclusively due to the quality of the teacher, but also the underlying differences in students.

D_{it} = Is a binary indicator equal to one if the teacher is a graduate of the online master's program. The coefficient δ is allowed to vary across grades. Given that the program is aimed at early elementary literacy instruction, we hypothesized that the program effect will be stronger on 1st and 2nd grade teacher effectiveness than in the upper elementary grades. We also ran a model that treats the effect of the oERL as constant across grades to provide a sense of the overall difference in ORF achievement between the comparison groups.

T_{it} = Is a vector consisting of two measures of teacher experience – the first is a binary indicator equal to one if the teacher has fewer than five years of experience. The second is a binary indicator equal to 1 if the teacher has 20 or more years of teaching experience. The sample does not include any teachers with fewer than 3 years of experience.

π_{st} = Is a school fixed effect that captures all unobserved factors that have a constant effect on a school's performance over the three years, but might also vary across each school. For example, the

school fixed effect may capture stable differences across schools in the quality of students that feed into the schools, or the quality of the administration and/or instructional program. Including the school fixed effect also helped us address the fact that we were not able to match each teacher to a support teacher within the same grade in the same school who also holds a master's degree. This approach ensures we do not attribute a difference in average ORF achievement between the students of the oERL teachers and those of comparison group teachers that is due to differences in the quality of their respective schools, rather than their instruction. The inclusion of school fixed effects means that the program effect – i.e. the difference in performance between the online master's and comparison group teachers' students – is estimated by examining the variation within schools.

γ_{gt} = Is a grade fixed effect for student i at time t ; the grade fixed effects in part control for systematic differences in ORF scores across grades, including those due to the normal deceleration of words-per-minute gains as students mature.

ν_i = Is a year effect to account for effects on ORF achievement that are constant across all students in the sample, but vary over time.

V. RESULTS

The results of the multilevel model revealed that the average student ORF predicted gain for oERL teachers across all grades was 2.89 words larger than the gain for the matched teacher comparison group (please see Table 4 for regression results for the HLM). This difference was statistically significant after controlling for student demographics, school reading program characteristics (i.e. Reading First, Instructional Facilitator), grade effects, and year effects. Table 3 presents the ORF gains predicted from the HLM for the oERL and matched comparison group by grade level. The data also reveal that the difference between the two groups was largest in 1st grade with students of oERL teachers showing gains in oral reading fluency that were 4.6 words greater on average than the students of the matched comparison group. In 2nd and 5th grade, the average student gain of the oERL teachers was 3.1 and 3.6 words greater, but they were not statistically different from the average student gain of the matched comparison groups. Very small and non-significant, but positive differences were found in 4th grade (0.6 words). The only grade where students of non-oERL teachers averaged larger gains than students of the oERL teachers was in 3rd grade, where the matched sample averaged fluency gains of 1.2 more words per minute than the students of the oERL teachers.

Table 3 helps determine the practical importance of the estimated differences. While the estimated 3.6 word difference between the oERL group and the comparison group in 5th grade appears small in magnitude, it represents a 11 percent increase in the comparison group's average fall to spring ORF gain of 16.2 words. The average reading gain of oERL 1st grade students was 7.6 percent higher than the average gain of the comparison group students. Similarly, the average gain in 2nd grade was almost 6 percent higher and the average gain in 4th grade was 1.1 percent higher. In 3rd grade, the oERL group averaged gains that were 2.4 percent smaller than those of the comparison group.

Reasons for the 3rd grade negative effect are unknown. The study was not able to include measures of teacher implementation, approaches to instruction, or the role of teacher education in the lesson preparation. It may be that some or all of the 3rd grade teachers did not respond to the program in the same way as the teachers in other grades, instructional strategies specific to 3rd-grade reading instruction were not sufficiently addressed by the program, the district reading curriculum differed significantly from the primary grades to grade 3, or that the district professional development and approach to reading in 3rd grade was a stronger influence than master degree attainment. Moreover, as with the observed positive effects of the oERL program, the negative 3rd-grade effect may be due to limitations of the research

design that include unobserved differences in the students, teachers, and/or schools and comparison samples that could only be addressed with randomization.

Table 3: Predicted Oral Reading Fluency Fall to Spring Gains

	Matched Comparison Group	oERL Teachers	Difference	Difference as % of Average Control Group Fall to Spring Gain
Grade 1	60.8	65.4	4.6	7.5%
Grade 2	53.7	56.8	3.1	5.7%
Grade 3	49.7	48.5	-1.2	-2.4%
Grade 4	50.5	51.0	0.6	1.1%
Grade 5	32.5	36.1	3.6	11.1%

Findings suggest that on average students of oERL graduates are making larger gains in oral reading fluency than students of comparable non-oERL graduates. Also, recall that a higher proportion of comparison group teachers had over 20 years of experience (82 percent vs. 66 percent). This suggests that oERL teachers were more effective despite the fact that on average they were less experienced than the comparison group teachers. The results reveal that the effect of the oERL program is not constant across all elementary grades. Students of 1st, 2nd, 4th, and 5th grade oERL teachers made larger average gains than their non-oERL counterparts; in 3rd grade the comparison group averaged larger gains.

Table 4: Returns of Online Masters Degree in Elementary Reading and Literacy on Oral Reading Fluency Scores

	Constant Effect Model		Grade-varying Effect Model	
<u>Program Effect Estimates</u>				
Online Masters Degree	2.89	***	4.55	**
oERL * Grade 2			-1.48	
oERL * Grade 3			-5.76	*
oERL * Grade 4			-3.99	
oERL * Grade 5			-0.94	
<u>Student Characteristics</u>				
Fall Oral Reading Fluency (ORF)	0.85	***	0.86	***
Black	-3.04	***	-3.02	***
Hispanic	-2.05	*	-2.10	*
ESL	-15.37	***	-15.33	***
Special Education	-16.71	***	-16.68	***
<u>Teacher/Classroom Characteristics</u>				
% Special Education	-4.38		-4.13	
Avg. Fall ORF	-0.02		-0.02	
% ESL	-16.32		-15.12	
Teaching Experience <=5 Years	-1.44		-1.90	

Teaching Experience >=5 Years	1.78		2.05	
<u>School Characteristics</u>				
Reading First	1.09		1.02	
Instructional Facilitator	-7.29	**	-7.38	**
% Special Education	47.80	**	46.22	**
Avg. Fall ORF	0.03		0.03	
% ESL	16.68		16.55	
<u>Grade Effects</u>				
Grade 2	-8.20	***	-7.11	***
Grade 3	-13.97	***	-11.16	***
Grade 4	-12.68	***	-10.37	***
Grade 5	-28.83	***	-28.32	***
Constant	61.46	***	60.83	***
Year Effects	Yes		Yes	
School Fixed Effects	Yes		Yes	
Obs = 3514	3514		3514	
R-Squared = 0.7327	0.733		0.716	

* p <.10; **p < .05; ***p <.01

Table 4 is provided as reference for those with a technical interest in the specification and results of the regression model. The table shows the outcome being predicted was the fall to spring gain on the DIBELS ORF. Each factor in the leftmost column of the table was a term used in the analysis because we expected it to associate with ORF gains. The numbers in the columns to the right of each factor represent the amount of additional gain attributable to that factor when all other factors are held constant.

The number we are most interested in is that next to the first term, oERL, which is an indicator of whether the teacher was an oERL graduate. This value tells us the average effect of the oERL teacher on students' ORF gains when all other factors (race, ESL, special education, Reading First, Instructional Facilitator, etc.) are held constant. It is our "treatment effect". The second column presents the results of a regression model where we assume the "oERL effect" on ORF gains is constant across all grades. That is, we assume a first grade oERL teacher has the same effect on ORF gains as a fourth-grade oERL teacher, etc. This model is used to give us an "average" effect of the oERL teachers over all students in all grades in the sample, which we found to be 2.89 additional words per minute. The third column presents the results of a regression model where we test to see if the "oERL effect" is different across grades. That is, we test to see if the effect of first-grade oERL teachers are statistically different than the effect of second-, third-, fourth-, or fifth-grade oERL teachers. In this table, the number for oERL (5.41) is actually the "oERL effect" for first-grade teachers. To get the "oERL effect" for the other grades, one needs to add 4.55 to the numbers next to the terms: second grade* oERL, third grade*oERL, fourth grade*oERL, fifth grade*oERL. For example, to calculate the oERL effect for fifth-grade students, one would add -1.48 to 4.55 and arrive at 3.07 (or 3.1 rounded).

Grade-level indicators are included to control for the normal level of gains made within each grade level, which differs by grade level for the ORF gains. The numbers presented for second grade, third grade, fourth grade, and fifth grade are negative because they are in reference to the average first-grade gain, which is captured in the constant term. The constant is the average value in the sample after all other

factors are controlled. In this case, it is interpreted as the average gain for first-grade students in the comparison group after all other factors are held constant. For example, the constant value of 60.83 shown in column 3 is the average ORF gain for first-grade students of comparison group teachers, while controlling for student factors (ethnicity, ESL status) and school factors (Reading first, instructional facilitator). The model also includes year indicators to account for differences in overall performance each year.

VI. SUMMARY/CONCLUSIONS

Results of this study support the view that the graduates of the oERL program had a significant influence on the oral reading fluency of elementary school students in this large urban district. When compared to other teacher education program graduates in the same district, the oERL graduates appeared to outperform graduates from other programs in all but one grade. Although the study lacks information on which comparison group teachers, if any, received their degrees via an online program, it is reasonable to hold that these particular findings reflect positively on teachers known to have received their content and pedagogical training through an online teacher education program. Given the significant finding for teachers in this analysis and their impact on student achievement, LEAs that control the recruitment, hiring, and development of teachers might want to give greater consideration to recruits from online teacher education programs. It also gives traditional teacher education programs further evidence that it is possible to create a standards-based education program that can be delivered fully online and meet the diverse access and learning needs of schools, teachers, and students.

The study has two potential threats to validity: differences in program emphasis between the treatment and comparison groups, and potential self selection bias. Literacy instruction is a key responsibility of primary and elementary school teachers, and the extent to which teachers succeed in teaching literacy is the outcome studied. The study does not seek to compare the oERL program to other elementary literacy programs; it seeks to compare the effects oERL program graduates to other degree program graduates. Because of this, the teacher's master's degree is not an attribute of the teacher that we want to make exactly comparable for the treatment group (oERL teachers) and comparison group (non-oERL teachers). Rather, it is the *treatment*, or *intervention* that we are evaluating to determine if it associates with increased teacher effectiveness, as measured by student reading achievement. To evaluate the effectiveness of the oERL, we needed to specify a comparison group with which to compare it. The comparison group we chose could be driven by any one of the following questions: (1) does the oERL program perform better than the average of all the other teacher education programs used in the field? (2) does the oERL program perform better than those teacher education programs that are most commonly experienced? (3) does the oERL perform better than other similar teacher education programs? However, this study sought to find evidence to answer the first question: Does the oERL program make teachers more effective at reading instruction than the average of other master's degree programs given we did not have information on the institutions attended for comparison group participants?

The goal of early-stage research, such as this, should be to compare the experience (treatment) to a very different control conditions to see if you can identify a *main effect* of the program. We have made the case in the literature review that the combination of modality for delivery and content-approach for the oERL likely makes this program unique. Once a main effect has been established, it makes sense to proceed to comparing the oERL program to similar other programs—an effort that will likely require larger sample sizes in order to identify statistically significant differences and access to data to allow the researchers to better identify relevant covariates.

While it is not necessarily a problem that treatment teachers received a degree specializing in elementary reading and literacy and control teachers may not have, it may be a problem if teachers who sought out

specialized reading and literacy programs were also more interested in reading instruction and motivated to improve their reading instruction. If this is the case, these teachers may be more effective reading instructors regardless of whether they attend the partner university's oERL program. This is the primary threat to validity that stems from self-selection into treatment groups. This threat can only be overcome via a stronger experimental or quasi-experimental design than presented here, thus we do not argue that there is a causal relationship between the oERL program and instructional effectiveness.

Limitations on the research design clearly would not allow for a claim of causation between the completion of the oERL degree and teaching effectiveness. However, the finding of a positive effect of the oERL program on student achievement provides suggestive evidence that the program may indeed improve the effectiveness of elementary literacy instruction. These findings help establish the empirical basis for subsequent experimental and quasi-experimental investigations of the efficacy of oERL programs. We recognize that since the inception of this particular research project useful roadmaps or guiding principles for carrying out research pertaining to online teacher education and professional development programs [30] and teacher effects analysis [37] have been published. Although we did not cover all of the requirements set forth by these researchers, we recommend that other researchers carefully consider them in conceptualizing future studies.

Additional analyses of the core content areas and tasks covered by the oERL such as those outlined in the International Reading Association [85], while beyond the scope of this study, would help in understanding which pedagogical content areas have the most significant impact on achievement. It would also be useful to replicate Palardy and Rumberger's [37] consideration of attitudes and practices, or Konold, et al's [7] attempts to understand teacher education program influences on teacher behaviors that affect student learning, including "whether these teachers are likely to change their behaviors when confronted with pupils not learning [37, p. 310]. Studies in progress by the authors and the oERL program analyze changes in teacher effectiveness pre and post degree attainment, using teacher influence on student reading scores as the outcome measure, and will enable consideration of the effects of curricular changes on teaching and learning.

Nonetheless, we believe "the *usefulness*" of this small, comparison group study to be that *it contributes to the larger body of work from which evidence can be triangulated* [6, p. 15] and pragmatically, that it supports the view that the type of educational background a teacher brings to the classroom is associated with student achievement. Such evidence should continue to prompt LEAs and teacher educators to continue to propose studies that seriously consider background characteristics in their research designs and look closely at the impact of teacher education curriculum on the instructional approaches of teachers and the relationship of these instructional approaches to student learning.

VII. ABOUT THE AUTHORS

Dr. Barbara Weschke is the program director of the Master's in Education in Early Reading and Literacy, pre-k-12, at Walden University; she also oversees the university's programs in Literacy and Learning in the Content Areas, grades 6-12; and the Adolescent Reading and Literacy, grades 6-12 programs in The Richard W. Riley College of Education and Leadership. She has taught in the literacy programs for the university, and is the former chairperson of English Language Arts for the Huntington, New York, school district where she implemented many in-service professional-development workshops on raising the standards for teacher performance; gender-role issues; and the use of technology in the classroom. In addition, she has provided leadership activities for students, relating to advanced-placement studies, and the college-application process. Dr. Weschke has published, and presented at international and national conferences on the topics of literacy, literature, and professional development, as well as on the topics of rural education, gender issues, the faculty-evaluation process; and parental involvement to

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