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Abstract

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Keywords

kindergarten, early childhood education, pre-service training, teacher training, Ghana, sub-Saharan Africa

Disciplines

Developmental Psychology | Early Childhood Education | Education | Other Psychology | Pre-Elementary, Early Childhood, Kindergarten Teacher Education

Impacts of Pre-Service Training and Coaching on Kindergarten Quality and Student Learning
Outcomes in Ghana

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Abstract

Using a randomized-control trial, this study evaluates a program designed to support Ghanaian kindergarten student-teachers during pre-service training through mentorship and in-classroom training. Several potential barriers to teaching quality and learning outcomes are examined.

Findings show that the program improved knowledge and implementation of the national curriculum for individuals both when they were student-teachers and, the following year, when they became newly qualified teachers (NQTs). There were mixed impacts on professional well-being, increasing personal accomplishment and motivation but decreasing job satisfaction for NQTs. There were mixed impacts on teaching quality, with increases in child-led learning but decreases in some other aspects of quality. There were no impacts on NQTs' student learning outcomes. The findings highlight system level challenges with both the posting of NQTs and the absence of support in their first teaching year. Implications for global early childhood education policy and teacher education are discussed.

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Introduction

International efforts to increase access to high-quality early childhood education have risen dramatically in recent years. Sustainable Development Goal 4, Target 4.2, calls for “ensur[ing] that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education” (United Nations, 2015). For this target to be achieved, governments will need to focus on both access to pre-primary education (e.g., by incorporating it into the basic education system) and ensuring the delivery of high-quality education (e.g., by producing a well-trained teacher workforce). Ghana has been a pioneer in these efforts, expanding 2 years of pre-primary education—called kindergarten 1 (KG1) and kindergarten 2 (KG2)—as part of its universal basic education system in 2008. With some of the highest enrollment rates in early childhood education (ECE) on the continent at over 80% net enrollment in 2015-16 (Ghana Ministry of Education, 2016; UNESCO, 2015), Ghana’s government has turned its attention the issue of quality, including developing a pre-service teacher certification track specifically for the KG level.

Developing and expanding a high-quality pre-service training program is one of top priorities of the Ghana Education Service in the Ministry of Education (MoE). Seven of the 40 colleges of education in Ghana currently offer a track for kindergarten teachers. Pre-service certification is a 3-year process, with 2 years of coursework and 1 year in a classroom as a student-teacher. While the MoE is currently working to align the content of coursework across all colleges of education and universities through the Transforming Teaching, Transforming Learning (T-TEL) initiative (Ministry of Education, 2017), there is no specified training during the student-teaching year. This study evaluates the impacts of a training program implemented during the student-teaching year using a randomized control trial. The program provides KG

student-teachers with guidance through mentorship and in-classroom training throughout their placement year focused on successful implementation of the national curriculum and KG-specific pedagogy. This study followed teachers over the course of two academic years, with impacts assessed on student-teachers at the end of the school year and during the following year when student-teachers were placed as full-time newly qualified teachers (NQTs). It is one of the first longitudinal impact evaluations of a pre-service pre-primary teacher training program in sub-Saharan Africa (SSA).

Early Childhood Education Quality

Numerous studies have shown that a significant portion of variance in student learning is explained at the classroom level (Rivkin, Hanushek & Kain, 2005), and that features of the classroom context meaningfully predict student learning outcomes and academic trajectories (e.g., Hamre & Pianta, 2001; Mashburn et al., 2008). *Process quality*, considered the driver of child learning and development, refers to the nature of children's daily interactions and experiences in the classroom, with a broad focus on the social, emotional, physical, and instructional aspects of activities and interactions. *Structural quality* refers to regulable resources, such as class size, student-to-teacher ratio, and teacher training and education (Slot, Leseman, Verhagen, & Mulder, 2015) and is considered important for improving learning outcomes only to the extent that it promotes process quality (Pianta et al., 2005; Seidman & Tseng, 2011). While the majority of evidence on the role of pre-primary classroom quality in promoting learning comes from U.S. contexts (see Yoshikawa et al., 2013), increasing evidence from low- and middle-income countries (LMICs) points to similar associations. This growing body of evidence comes from both descriptive (Aboud, 2006; Brinkman et al., 2017; Leyva et al., 2015; Rao et al., 2014) and experimental and quasi-experimental studies (Araujo, Carneiro,

Cruz-Aguayo, & Schady, 2016; Yoshikawa et al., 2015).

The primary question countries face is *how* to promote both structural and process quality and learning in their education systems. While some models have been evaluated in low- (Özler et al., 2017) and middle-income countries (Yoshikawa et al., 2015; for reviews see Ganimian & Murnane, 2016, and Conn, 2017), the majority of studies concerned with teacher professional development have focused on in-service teacher training. Yet pre-service training is the base from which teachers develop their practice. While some evidence suggests that new teachers adjust their practice to the local school environment in ways that may ‘wash-out’ the effects of their pre-service training (Westbrook et al., 2009), other studies suggests otherwise. In a study across six countries in SSA, including Ghana, Akyeampong, Lussier and Westbrook (2013) found that pre-service training experiences had a powerful effect on the teaching practice of new teachers, and also induced misplaced confidence leading to standardized teacher-led approaches that failed to engage students. If and how pre-service training can be modified to induce long-term impacts on teaching knowledge and practice is an area in need of research.

Teacher Professional Well-being

Ghana’s education system was regarded as one of the most highly developed and effective in West Africa and the teaching profession was held in high esteem in the 1960s and 70s. However, the education system has deteriorated since, and a major present-day challenge is the inability to attract high caliber candidates to become teachers (Adu-Gyamfi, Donkoh & Addo, 2016). Teachers in LMICs face many challenges, including increasing workloads due to education reform, low and infrequent teacher remuneration, lack of professional recognition, challenging working conditions (i.e., large class sizes), lack of accountability, minimal professional development opportunities, and lack of voice (Bennell & Akyeampong, 2007;

Author). There is growing concern about a “motivation crisis” among teachers in LMICs (Moon, 2007) and in Ghana specifically (Bennell & Akyeampong, 2007). Teacher motivation and attendance, as well as high rates of turnover (Osei, 2006), are serious challenges to improving educational quality and child learning in Ghana and other LMICs (Bennell & Akyeampong, 2007; Chaudhury et al., 2006).

In addition to motivation, three other areas of professional well-being have been found to predict teaching outcomes in high-income countries. Job burnout is a psychological syndrome in response to chronic work stressors (Maslach, Schaufeli, & Leiter, 2001), and has been associated with job withdrawal, absenteeism, intention to leave the job, and turnover. For people who stay on the job, burnout leads to lower productivity and effectiveness at work across various professions (Kop, Euwema, & Schaufeli, 1999; Leiter, Harvie, & Frizzell, 1998; Vahey, Aiken, Sloane, Clarke, & Vargas, 2004). Personal accomplishment has been linked to different dimensions of burnout, and to student behavior patterns (Hastings & Bham, 2003). Finally, teacher job dissatisfaction has been found to be a primary reason for leaving the profession (Green-Reese, Johnson, & Campbell, 1992; Hall, Pearson, & Carroll, 1992), and job satisfaction a key predictor in teacher retention (Zigarelli, 1996). Few impact evaluation studies have considered professional well-being for teachers in SSA and in pre-service training contexts. But evidence suggests that improving teacher professional well-being may be an important component of any professional development effort.

Kindergarten Education in Ghana

Ghana’s 2004 National Early Childhood Care and Development Policy highlights access to quality kindergarten education as central to improving early childhood development and learning, and as a promising way to prevent development delays and foster early learning despite

adversity. In 2007, the government expanded access to 2 years of pre-primary education—called Kindergarten (KG)—by including it in the free and compulsory basic education provided by the state starting in 2008. It was the first country in SSA to do so. The KG system is accordingly financed as part of the primary school system. The curriculum emphasizes play and joy of learning, as well as creativity, prosocial skills, and active engagement, as key elements of KG education (Ministry of Women and Children’s Affairs, 2004). Yet recent reports on the KG sector have concluded that the curriculum is rarely implemented, and that quality is low across the country (GES, 2012; UNESCO, 2006).

Pedagogical practices observed in several studies in Ghana are highly teacher-directed and considered to be oppressive of young children (Adu-Gyamfi, 2014; Akyeampong, 2017), with children viewed as “receptacles in need of control” (Agbenyega, 2017, p. 682). Thus, despite the national curriculum being play-based and child-centered, it is rarely implemented as intended (Ghana Education Service, 2012). Some have argued that the greatest need for Ghanaian early childhood teachers is to transform experiences to see “best practice” and change teachers’ beliefs and value systems by changing the way teachers are educated (Agbenyega, 2017; Akyeampong, 2017; Akyeampong & Lewin, 2002). While questions may remain about the appropriateness of child-centered pedagogical approaches in Ghana, a recent study showed that training teachers on these approaches led to increased use of child-friendly practices and improved early literacy, early numeracy, and social-emotional development for KG children (Author).

Effective Teacher Training Programs

Few, if any, experimental studies have considered how effective different types of pre-service training programs are in changing teachers’ pedagogical beliefs and attitudes, and,

perhaps more importantly, the quality of teaching and learning in SSA. A synthesis of 115 rigorous evaluations of in-service training educational initiatives in LMICs concluded that resources improve student achievement only if they change children's interactions at school (Ganimian & Murnane, 2016). Two other meta-analyses came to similar conclusions. McEwan (2015) found that across educational interventions evaluated in LMICs, programs that used computers or instructional technology, teacher training, and smaller classes / learning groups had the largest impacts on learning outcomes. Conn (2017) focused on studies in sub-Saharan Africa only, and found that programs that alter teacher pedagogy or classroom instructional techniques had an effect size approximately 0.30 standard deviations greater than all other types of programs combined. Finally, Evans and Popova (2015) conducted a review of meta-analyses analysing educational interventions in sub-Saharan Africa, and concluded that pedagogical interventions that tailor teaching to student skills, repeated trainings, and improving accountability have been most consistently shown to improve student learning outcomes.

These findings point to the importance of not only training teachers in instructional content but in helping teachers improve their daily interactions with students to change children's daily school experiences. In low-resourced countries, in particular, efforts to improve teaching practice are not successful without specifically guided instruction (Ganimian & Murnane, 2016). These findings parallel a robust and growing evidence base on successful teacher professional development programs in high-income countries, showing the effectiveness of an outside expert providing frequent ongoing support to teachers inside and outside of the classroom (Kraft, Blazar, & Hogan, 2018). For example, interventions designed to provide intensive, individualized coaching to teachers has shown improved teacher-child interactions, especially in high-poverty classrooms (Brown, Jones, LaRusso, & Aber, 2010; Raver et al.,

2011) and substantial gains in student achievement (Allen, Pianta, Gregory, Mikami, & Lun, 2011). A recent study in Ghana found a similar pattern of results (Author).

In their meta-analysis, Kraft and colleagues define coaching programs broadly as all in-service professional development programs where coaches observe teachers' in the classroom and provide feedback to help them improve. While coaching fits under the broader umbrella of teacher professional development, Kraft and colleagues see it as distinct from most program offerings, which still consist of short-term and generalized workshops. Interestingly, 51 of the 60 studies reviewed included teachers from kindergarten or elementary school, suggesting that early school grades may be a period where coaching has the potential to be most effective.

A recent study of pre-service teacher educators in Ghana identified a hierarchical relationship between teacher educators and school teachers, as well as a lack of experiential learning opportunities, as key barriers to the implementation of a child-centered approach in education (Akyeampong, 2017). As a result, opportunities for in-classroom coaching and supportive feedback are limited. Building on best practices of teacher coaching from teacher professional development programs, the Fast-track Transformational Teacher Training Program was designed to directly address these barriers.

The Fast-track Transformational Teacher Training (FTTT) Program

The FTTT program was developed in partnership between the Ghana Education Service (part of Ghana's MoE), one of Ghana's colleges of education, and a local nonprofit organization [names redacted for privacy purposes]. It is implemented during the certification training of KG student-teachers include a pre-service training program. A sensitization training targeting head teachers to support the implementation of the curriculum was also developed and tested.

Pre-service training program for student-teachers. The program model is one of

mentoring, in-classroom coaching, and experiential learning, with the goal of training KG teachers in play- and activity-based teaching practices based on the KG-specific pedagogy outlined in the national curriculum (GES, 2012). The training also teaches student-teachers how to use a thematic (topic-based) approach to lesson planning, as well as structurally how to set up a classroom in a child-friendly way (e.g., ensuring there is clean water to drink, hanging children's work on the walls at eye-level).

The structure of the program builds on the standard 3-year certification program in Ghana's colleges of education, which includes placement in a standard KG classroom in the third year of training with mentorship from the teacher of that class. Guided training does not continue in this year, and the scope and quality of the mentorship is determined by the classroom teacher. FTTT augments the student-teacher placement year with intensive and guided in-service training and support. Student-teachers are placed in schools with "model practice classrooms," which provide them with enhanced training, coaching, and mentoring by FTTT trainers. The enhanced training services include 12 days of intensive workshops, in-classroom coaching by the KG teacher, one-on-one feedback meetings with trainers, and a best-practices forum for student-teachers to share their experiences with each other. These trainings and support focus on a 'scheme of work' that links the Ghanaian KG curriculum objectives and child development goals to specific activities, which in turn are linked to a structured daily plan that teachers follow. While teachers have flexibility in the content of the activities they implement throughout the day, all classrooms follow the same daily timetable.

The model practice classrooms are given a "starter pack" of materials, including paper, activity toys, and theme-related storybooks. Teachers also receive a Teacher Resource Toolkit, which provides ideas on how to make additional teaching materials from low-cost and readily

available materials and access to KG-specific learning resource templates, which can be replicated at minimal cost. Finally, the program includes sensitizing parents to the program's approach through KG-specific Parent-Teacher Association meetings.

Head teacher sensitization training. One potential barrier to the longer-term success of the FTTT program lay in teachers' experience the following year when placed as newly qualified teachers (NQTs). After being trained in the methods promoted in the FTTT program as student-teachers, NQTs might be discouraged from using these practices in their placement schools. Given that the methods promoted in the KG curriculum and the FTTT program are quite different than those in primary school, parents and head teachers may discourage teachers from teaching in this style in favor of a more rigorous and academic focus (Bidwell & Watine, 2014; Choi, 2006; Author). Sensitizing and training head teachers on the KG curriculum and FTTT teaching practices may reduce this barrier.

The program evaluated was a 4-day retreat and included an introduction to and overview of early childhood development, the national KG curriculum, and the FTTT program. This study tests the added value of a sensitization training for the head teachers in NQTs' placement schools. Figure 1 presents the theory of change through which the FTTT program and head teacher sensitization training were expected to improve teaching and learning outcomes.

The Present Study

This study assesses the impacts of the FTTT program over the course of 2 academic years: the student-teacher year during which the intervention occurred, and the following year as student-teachers became full-time newly qualified teachers (NQTs). Little systematic evidence exists on the placement process for NQTs in Ghana, and in this sample a significant portion of teachers were placed as NQTs in non-KG primary school classrooms. Thus, I also consider how

placement moderates treatment impacts. Specifically, this study addresses five research questions:

1. Does FTTT increase student-teachers' implementation and knowledge of the national curriculum, and do these impacts persist the following year when placed as newly qualified teachers (NQTs)?
2. Does FTTT improve professional well-being and the quality of teacher-child interactions for student-teachers and, subsequently, for NQTs?
3. Does FTTT improve the learning outcomes of students of NQTs who were trained in the FTTT program?
4. Does a head teacher sensitization training in NQT placement schools improve the program's effectiveness?

Methods

Participants and Research Design

The FTTT program was evaluated in the Western region during the 2015–2016 and 2016–2017 academic years through a randomized control trial. The trial was registered in the American Economic Associations' registry for randomized controlled trials (RCT ID: AEARCTR-0002322). Participants included the full cohort of KG student-teachers completing coursework from Holy Child College of Education in 2015. A baseline survey was conducted in June 2015 as student-teachers were finishing their coursework prior to their placement year, after which 137 student-teachers were randomized to be placed in either an FTTT treatment school (23 schools) or a control school practicing "business as usual" (23 schools). Using random assignment, 69 teachers were assigned to the treatment group and 68 teachers to the control group. Two teachers assigned to the control group left the certification program before the

student teaching year, leaving 66 in total for that group. Figure 2 depicts the timeline, sample, and randomization process.

Data collection occurred in four rounds over 3 academic years. The baseline survey (baseline) occurred prior to randomization and collected basic demographic information, language proficiency, and basic pre-literacy skill knowledge before the student-teaching year of training. This was a self-administered survey. Following baseline, student-teachers were randomized into FTTT and non-FTTT schools, and the second round of data (follow-up 1) was collected at the end of the student-teacher year (June 2016).

The following academic year (2016–2017), student-teachers became newly qualified teachers (NQTs) and were posted to teach in schools in eight regions across Ghana. The final two rounds of data collection occurred in this academic year: October/November (follow-up 2) and May/June of that year (follow-up 3). All three rounds of follow-up data collection included an administered teacher survey and classroom observations to assess teaching quality. Follow-up 2 and 3 also included direct child assessments of a randomly selected sample of children in each teacher's class ($N = 15$ per teacher). Table 1 depicts the type of data collected at each round.

NQT placement. The eight regions in which NQTs were placed were Ashanti (15 teachers), Brong Ahafo (5), Central (16), Eastern (4), Greater Accra (7), Northern (1), Upper East (1), and Western (81). While the majority of teachers were placed in KG classrooms, 29 teachers (21.5%) were placed in non-KG classrooms (four in junior high school, one in primary 4, one in primary 5, seven in primary 3, seven in primary 2, and nine in primary 1).

Teacher surveys assessing professional well-being and ECE knowledge were administered to all teachers regardless of placement. Classroom observations were conducted for teachers in KG and primary 1 through 3 classrooms. Child assessments were conducted for all

KG and primary 1 teachers.

In addition, at different waves, some teachers were not available or refused to participate in the data-collection process. Specifically, at follow-up 2 ($N = 129$), two treatment teachers did not participate in data collection (one was on maternity leave, one had not yet posted to her placement school) and four control group teachers did not participate (two refused, one passed away, and one had not yet posted to her placement school). At follow-up 3 ($N = 131$), all treatment school teachers participated in data collection, while four control group teachers did not (the same two teachers refused again, one was on maternity leave, and the teacher who passed away). In addition, three videos of the classroom observations could not be opened due to the video files becoming corrupt. As a result, the sample had some missing data at each wave.

Assessment Development and Adaptation

Extensive work was done to ensure that all measures were culturally and contextually appropriate. For the *teacher surveys*, items were selected from existing scales and were pilot tested. First, five cognitive interviews were conducted with teachers to assess whether they understood each question, both consistently across constructs and in the way the item was intended (Collins, 2003). Next, the survey was piloted with 20 teachers, and the distribution for all items was assessed. Following both of these exercises, suitable items were selected for use in this sample. Notably, all items have been used in previous research with teachers in SSA (Author). The *classroom observation tools* were adapted to and used in Ghanaian KG classrooms in previous recent research (Author).

Finally, the child assessment tool was translated into three local languages (Twi, Ewe, and Ga). Surveys were translated and then back-translated by a different person to check for accuracy. Any discrepancies were discussed and addressed. After being trained on the

instrument, a group of surveyors read and discussed the translated version in their respective local language and made additional changes as a group. While the tool used was designed to be implemented widely across culturally diverse settings, the current protocol was reviewed by local child development experts and piloted with 10 children in the Accra metropolitan area and 10 children in the Greater Accra Region to confirm its appropriateness for the study context. Only minor adaptations were required (e.g., removing the word “please” from the start of several questions and simplifying the instructions by removing excessive words). In regions with a different local language, a local translator was hired and trained on the assessment protocol and on conducting research with children. The translators accompanied the trained enumerators in schools where the respective local language was spoken.

Measures

ECE knowledge. Teachers’ knowledge about developmentally appropriate practices in KG was assessed using three sub-scales of the Perceptions of Quality in Early Care and Education scale (Cleveland, Susman-Stillman & Halle, 2013). All items were assessed on the following scale: 1 = not important, 2 = not very important, 3 = somewhat important, 4 = important, and 5 = very important. These scales were administered only during the NQT year.

Developmentally appropriate practice was measured using six items ($\alpha = 0.66$ and 0.67 at follow-ups 2 and 3, respectively). Sample items for developmentally appropriate practice included “When you think about quality in a kindergarten setting, how important is it that KG teachers know about children’s needs as they grow and develop?” and “When you think about quality in a kindergarten setting, how important is it that KG teachers provide materials for play and learning?” ($M = 4.80$, $SD = 0.34$ at follow-up 2; $M = 4.79$, $SD = 0.33$ at follow-up 3).

Supporting social and emotional development was assessed using five items ($\alpha = 0.74$

and 0.71 at follow-ups 2 and 3, respectively). Sample items for supporting children's social and emotional development included "When you think about quality in a kindergarten setting, how important is it that KG teachers help children to build relationships with peers and adults?" and "When you think about quality in a kindergarten setting, how important is it that KG teachers help children resolve conflicts with other children?" ($M = 4.23$, $SD = 0.63$, and $M = 4.64$, $SD = 0.30$ at follow-ups 2 and 3, respectively).

Finally, knowledge about *family-sensitive caregiving* was measured using five items ($\alpha = 0.50$ and 0.75 at follow-ups 2 and 3, respectively). Sample items for family-sensitive caregiving included "When you think about quality in a kindergarten setting, how important is it that KG teachers be willing to work with parents about their work schedules?" and "When you think about quality in a kindergarten setting, how important is it that KG teachers be willing to care about the entire family, not just the child?" ($M = 4.59$, $SD = 0.38$, and $M = 4.17$, $SD = 0.68$ at follow-ups 2 and 3, respectively).

Motivation. Motivation was measured as a scale using five items adapted from Bennell and Akyeampong (2007) as reported in Torrente et al. (2012). These items were assessed on the following scale: 1 = false, 2 = mostly false, 3 = sometimes true, 4 = mostly true, 5 = true. Sample items for motivation include "I am motivated to help children develop well socially" and "I am motivated to help children learn math" ($M = 4.59$, $SD = 0.54$, $\alpha = 0.68$ at follow-up 1; $M = 4.60$, $SD = 0.46$, $\alpha = 0.57$ at follow-up 2; and $M = 4.62$, $SD = 0.59$, $\alpha = 0.67$ at follow-up 3).

Job satisfaction. Teacher's job satisfaction was measured at all three rounds using six items adapted from Bennell and Akyeampong (2007) as reported in Torrente et al. (2012). These items were assessed on the following scale: 1 = true, 2 = somewhat true, 3 = somewhat false, 4 = false. Sample items for job satisfaction included "I am satisfied with my job at this school" and

“Other teachers are satisfied with their decision to be a teacher in this school.” Responses to each item were recoded so that higher scores would imply higher job satisfaction ($M = 2.00$, $SD = 0.41$, $\alpha = 0.53$ at follow-up 1; $M = 2.26$, $SD = 0.38$, $\alpha = 0.72$ at follow-up 2; and $M = 2.13$, $SD = 0.40$, $\alpha = 0.70$ at follow-up 3).

Burnout. Burnout was measured at all three rounds using 11 items from the Maslach Burnout Inventory (Maslach, Jackson, Leiter, 1996). Items asked teachers to use a scale from 1 (never) to 7 (every day) to indicate, for instance, how often “I feel emotionally drained from my work” and “I feel fatigued when I get up in the morning and have to face another day on the job” ($M = 2.31$, $SD = 1.08$, $\alpha = 0.77$ at follow-up 1; $M = 2.25$, $SD = 0.98$, $\alpha = 0.71$ at follow-up 2; and $M = 2.21$, $SD = 0.94$, $\alpha = 0.68$ at follow-up 3).

Personal accomplishment. Personal accomplishment was measured at all three rounds using eight items from the Maslach Burnout Inventory (Maslach et al., 1996). Items asked teachers to use a scale from 1 (never) to 7 (every day) to indicate, for instance, how often “I can easily understand how my school children feel about things” and “I feel excited after working closely with my school children” ($M = 6.27$, $SD = 0.86$, $\alpha = 0.69$ at follow-up 1; $M = 5.84$, $SD = 1.02$, $\alpha = 0.68$ at follow-up 2; and $M = 6.19$, $SD = 0.93$, $\alpha = 0.72$ at follow-up 3).

Classroom observation. In all follow-up data collection rounds, teachers were videotaped teaching a lesson in their classrooms for 30–45 minutes. Videos were then coded by trained assessors on the basis of two instruments: a checklist of developmentally appropriate practices promoted in the training, and a tool to assess the quality of teacher–child interactions.

Implementation of curriculum. Two checklists were created to assess the extent to which teachers were using the practices explicitly covered in the FTTT training. *Materials* included 10 practices related to how teachers set up their classrooms, including if there was at

least one learning center, a daily plan/schedule displayed, classroom rules displayed, the classroom being physically clean and tidy, children's work displayed, and at least one story map visible (i.e., structural quality). This was collected at the school at the same time as the video recording was taken. Each item was coded as either present (a score of 1) or absent (a score of 0) in the classroom ($M = 5.6$, $SD = 3.1$ at follow-up 1; $M = 3.1$, $SD = 2.0$ at follow-up 2; $M = 3.7$, $SD = 2.6$ at follow-up 3).

Activities items included a checklist of 13 activities related to behavior management and instructional practice (i.e., process quality). Each practice was coded as either present in the video (a score of 1) or absent in the video (a score of 0). Items included: "Teacher praises children for positive behavior"; "Teacher threatens children with or used a cane on children at least once (reverse coded)"; "Teacher explicitly reminds children of the class rules"; "Teacher uses a signal to gain children's attention (e.g., drum beat, song, bell)"; "Children are seated in a way that children can see each other's faces (e.g., in a circle, or tables together in groups)"; "Teacher uses one or multiple songs to facilitate learning at some point in the lesson"; and "There is an activity that facilitated the lesson objectives that involved manipulation of materials" ($M = 3.7$, $SD = 1.8$ at follow-up 1; $M = 3.7$, $SD = 1.6$ at follow-up 2; $M = 4.0$, $SD = 1.6$ at follow-up 3).

Teacher-child interactions. Teacher-child interactions were assessed using the Teacher Instructional Practices and Processes System (TIPPS) (Seidman, Raza, & Kim, 2017; Seidman, Raza, Kim, & McCoy, 2013). The TIPPS is a classroom observation tool for assessing classroom quality that focuses on the nature of teacher-child interactions (i.e., process quality) and was created for use in low- and middle-income countries. The TIPPS-Early Childhood Education version was used and minor adaptations were made for use in Ghana through consultations with

local teachers and educators, as well using videos collected in KG classrooms in Ghana as part of another research study (see Author). The factor structure of the TIPPS, as well as teacher-level predictors of these factors and their associations with children's learning outcomes in Ghanaian KG classrooms have been shown in two previous studies (Author).

Child-led learning. Two items pertain to teachers' support of child-led learning in terms of individually child-driven activities and children learning from their peers. Due to low prevalence, two items were dichotomized if they were observed to any degree in the classroom: 'Teacher supports children's development through the use of free playtime' and 'Teacher structures learning activities in a way that children learn to work, play and share with others'. The two dichotomized items were added together to create a total score. Notably, in the previous data collected in Ghana (Author), these two items were completely absent from observed classrooms and thus not included in previous studies using the TIPPS.

Supporting student expression: This scale is made up of four items: considers student ideas and interests; encourages students to reason and problem solve; connects lesson to students' daily lives; and models complex language. Specifically, the items are: 'Teacher uses pupils' ideas and interests to inform classroom activities and assignments'; 'Teacher encourages pupils to reason and problem solve'; 'Teacher connects pupils' studies to their everyday life experiences, showing the relevance of lessons outside the classroom'; and 'Teacher models use of language to encourage students to be expressive and communicative of their ideas in the classroom' ($\alpha=0.64, 0.59, \text{ and } 0.65$ at follow-up 1, 2, and 3, respectively). The scale was derived based on previous factor analyses using the TIPPS in Ghanaian KG classrooms (Author citation redacted).

Emotional support and behavior management: This scale is made up of seven items

related to positive climate; negative climate; sensitivity and responsiveness; tone of voice; positive behavior management; provides consistent routines; and student engagement in class activities. Specifically, the items are: ‘Behavioral indications of positive environment between teacher and pupils and amongst peers’; ‘Teacher sensitivity and responsiveness to pupils’ needs and learning’; ‘Behavioral indications of negative environment between the teacher and pupils and amongst peers’; ‘Teacher uses appropriate tone of voice and expression when interacting with pupils’; ‘Teacher manages pupil misbehavior through effective behavior management techniques’; ‘Teacher creates a consistent routine for the classroom that pupils can easily follow’; and ‘Pupils are engaged in classroom learning and activities’ ($\alpha=0.61, 0.52, \text{ and } 0.70$ at follow-up 1, 2, and 3, respectively). The scale was derived based on previous research using the TIPPS in Ghanaian KG classrooms (Author citation redacted).

Reliability. Video coders were trained and had to achieve the pre-specified levels of reliability in order to pass the training. Raters were recruited in Ghana, had a bachelor’s or master’s degree, and attended a 5-day training session on the instrument. Each rater had to meet or exceed a set of TIPPS calibration criteria within three attempts to be certified as a TIPPS observer. The calibration criteria not only look at agreement but also the degree of deviation from master codes—both important aspects given that there are only four scale points and that understanding of the concept is critical for precise coding (see Seidman et al., 2013 for details on calibration cut-offs). Collectively, the criteria enhance the likelihood of achieving acceptable levels of inter-rater reliability. Raters who achieved calibration were also required to participate in 30-minute weekly refresher sessions led by TIPPS trainers that included a review of different manual concepts, short practice videos, and time for questions and discussion.

To assess inter-rater reliability, 15% of videos collected at baseline were coded by three raters. I calculated the ICC of the final scores to assess how the partition of variance in scores breaks

down into differences in individual raters and shared variance across raters. On average across items, 71.1% of the variance was shared across raters.

Student outcomes. Student outcomes were assessed in four areas relevant to school readiness: early numeracy, early literacy, social-emotional skills, and executive function skills. A fifth domain of children's approaches to learning was reported by the assessor. The instrument used was the International Development and Early Learning Assessment (IDELA), developed by Save the Children (Pisani, Borisova, & Dowd, 2015); its adaptation to the Ghanaian context is described above.

Early literacy. The domain of early literacy consists of 38 items grouped into six subtasks, and covers constructs of print awareness, letter knowledge, phonological awareness, oral comprehension, emergent writing, and expressive vocabulary. An example subtask on phonological awareness asked children to identify words that begin with the same sound. A sample item is: "Here is my friend mouse. Mouse starts with /m/. What other word starts with /m/? Cow, doll, milk" ($\alpha = 0.73$).

Early numeracy. The domain of early numeracy consists of 39 items grouped into eight subtasks and covers constructs of number knowledge, basic addition and subtraction, one-to-one correspondence, shape identification, sorting abilities based on color and shape, size and length differentiation, and completion of a simple puzzle. An example item assessing shape identification showed the child a picture with six shapes and asked the child to identify the circle ($\alpha = 0.71$).

Social-emotional development. The domain of social-emotional development consists of 14 items grouped into five subtasks, and covers constructs of self-awareness, emotion identification, perspective taking and empathy, friendship, and conflict and problem solving. An example item of conflict solving involved asking the child to imagine he or she is playing with a toy and another child wants to play with the same toy, and asking the child what they would do to resolve that conflict. "Correct" answers in the Ghanaian context as agreed upon by the assessors during training included

talking to the child, taking turns, sharing, getting another toy ($\alpha = 0.67$).

Executive function. The domain of executive function was assessed with ten items grouped into two subtasks focused on working memory (i.e., forward digit span) and impulse control (i.e., head-toes task). For the forward digit span, assessors read aloud five digit sequences (beginning with two digits and increasing up to six digits); children were asked to repeat the digit span, and their answers were marked as correct or incorrect. For the head-toes task, assessors asked children to touch their toes when the assessor touched his or her head, and vice versa in a series of five items ($\alpha = 0.70$).

Approaches to learning. After the assessor completed the IDELA items with each child, they filled out seven items about the child's approaches to learning. Each child was rated on a scale of 1 to 4, with 1 = "almost never" and 4 = "almost always." Assessors reported on children's attention (i.e., "Did the child pay attention to the instructions and demonstrations through the assessment?"), confidence, concentration, diligence, pleasure, motivation, and curiosity during the tasks ($\alpha = 0.95$).

Reliability. Inter-rater reliability on the child development outcome measure was assessed. Enumerators were paired and assessed and scored two children together. Cohen's *kappa* values were calculated for each pair across each item in the entire assessment; values ranged from 0.67 to 0.97, with an average of 0.86.

Control variables. A small set of covariates was included to improve the precision of impact estimates, including teacher age, how many of the teachers' family members lived nearby, whether the teacher was placed in a primary (non-KG) classroom, and regional fixed effects for the eight regions in which teachers were placed. For impacts at follow-ups 2 and 3 (the NQT year), a dummy variable was included for teachers who were placed in the same school together ($N = 26$). For child outcomes, the students' fall score for the respective outcome was also added to the model in addition to the other covariates.

Analytic Plan

Baseline equivalency. Table 2 presents differences in baseline teacher characteristics across treatment and control groups collected before randomization and before the student-teaching year began. Across all domains assessed, which include age, prior education level, marital status, language proficiency, and placement preferences, there were no differences in the treatment and control group student-teachers.

Missing data and multiple imputation. I used multiple imputation (with Stata's "ice" command) to address missing data (described above), using all four rounds of data collection in the imputation process. A large set of variables, including outcome variables from all four waves, treatment status, and a large set of demographic variables, were used in the imputation modeling. While most of the missing data were not missing completely at random (MCAR), if variables that strongly predict attrition are incorporated into the missing data strategy, the plausibility of a missing at random (MAR) assumption increases (Young & Johnson, 2015). In other words, including a large set of covariates in estimating multiple chains of models as well as variables that predict differential attrition, assumptions of MAR have been shown to be robust. Notably, attrition from longitudinal panel studies have been found to be unlikely to introduce much bias into model estimates (Fitzgerald, Gottschalk, & Mofitt, 1998). The multiply imputed data was used for teacher-level outcomes at follow-ups 2 and 3.

Impact analysis. All impacts were assessed using regression analysis. The specific approach differed depending on the wave of data collection. For impacts on teacher outcomes at follow-up 1, standard errors were adjusted for clustering of student-teachers within schools. For follow-ups 2 and 3, OLS regression analyses were used to assess impacts on teacher-level characteristics, as teachers were mostly placed individually within schools across the country.

For follow-up 2 and 3, impacts were assessed using the 20 multiply imputed datasets described above. Estimates were derived using Stata's "mi estimate" command, which uses Rubin's combining rules to compute pooled coefficients and standard errors across datasets (Rubin, 1987). Finally, to assess impacts on child outcomes at follow-up 3, two-level multilevel models (i.e., children nested in teachers) were used to account for the nested, non-independent nature of the data. All analyses were conducted in Stata 14.0.

Results

Research Question 1: Impacts on Implementation of Curriculum and ECE Knowledge

The first question addressed fidelity of implementation. Table 3 presents the impact estimates on implementation of the KG-specific pedagogy (measured at all three follow-up points) and teacher knowledge (measured at follow-ups 2 and 3). Large impacts are observed on both dimensions of implementation for student-teachers ($d = 2.40, p < .001$ and $d = 1.14, p < .001$ for materials and activities, respectively). Said another way, control group classrooms implemented an average of 3.2 KG-specific pedagogical materials compared to an average of 7.9 such materials in model practice classrooms. Regarding KG-specific pedagogical activities, control group student-teachers implemented 2.7 such activities compared to 4.6 activities for FTTT student-teachers.

The following year, as NQTs, treatment and control group differences persisted but were smaller. In the fall, control group teachers implemented an average of 2.7 of the materials compared to 3.5 in the treatment group ($d^1 = 0.38, p < .001$). In addition, control group teachers implemented an average of 3.5 the activities in the checklist compared to 4.1 for treatment group

¹ Standard deviations for treatment and control groups used to calculate effect sizes for teacher outcomes at follow-up 2 and 3 were computed using the pooled estimates across all imputed datasets using Rubin's combining rules (Rubin, 1987).

teachers ($d = 0.32, p < .001$). Notably, this measure was taken early in teachers' placement year, when they might have still been settling in to their new classrooms. In the spring, these impacts persisted, with treatment teachers showing larger improvements in their use of materials over the year. Control group teachers implemented an average of 2.7 of the materials compared to 4.7 in the treatment group ($d = 0.82, p < .001$). In addition, control group teachers implemented an average of 3.9 of the activities in the checklist compared to 4.4 activities for treatment group teachers ($d = 0.32, p < .001$).

Table 3 also shows the impact estimates on teacher knowledge, which was assessed only at the second and third follow-ups. There were moderate to large impacts of FTTT on NQTs' knowledge across three dimensions of early childhood development and ECE pedagogy in the fall: developmentally appropriate practice ($d = 0.44, p < .001$), supporting children's social-emotional needs ($d = 0.64, p < .001$), and family-sensitive practice ($d = 0.18, p < .001$). Impacts persisted in the spring with similar effect sizes.

Research Question 2: Impacts on Professional Well-being and Classroom Quality

Impacts on four dimensions of teachers' professional well-being were assessed: motivation, burnout, job satisfaction, and personal accomplishment. These were selected because they have been shown to be important in predicting teacher turnover and the way teachers interact with their students in the classroom. Impacts on professional well-being were mostly positive. As shown in Table 3, as student-teachers, FTTT teachers displayed higher levels of personal accomplishment ($d = 0.42, p < .05$). These impacts persisted for NQTs throughout the school year ($d = 0.19$ in the fall, $d=0.31$ in the spring, $p < .001$), indicating that FTTT increased teachers' feelings of accomplishment at their jobs. Treatment teachers also reported higher levels of motivation in the fall ($d = 0.23, p < .001$) and spring ($d = 0.10, p < .05$) and lower levels of

burnout in the spring ($d = -0.09, p < .05$). However, as NQTs, FTTT teachers also reported lower levels of job satisfaction both in the fall ($d = -0.10, p < .05$) and in the spring ($d = -0.37, p < .001$). This may be the result of the transition from a model practice classroom with ongoing monitoring and support to a full-time position with far fewer resources and support.

Regarding classroom quality, FTTT also changed classroom processes in the short time teachers were observed during data collection. These impacts were mixed. In all three rounds of follow-up data collection, treatment group teachers implemented significantly more child-led learning activities. But this difference declined in size with time, with large impacts for student-teachers ($d = 0.90, p < .001$), moderate-sized impacts in the fall for NQTs ($d = 0.36, p < .001$), and small impacts in the spring for NQTs ($d = 0.11, p < .05$). This indicates that teachers had difficulty sustaining practices taught in FTTT that were in direct contrast to traditional teaching approaches.

While the program increased child-led learning activities, it decreased teachers' support of student expression during the observed period. This was most pronounced for student-teachers ($d = -0.53, p < .05$), but persisted in the fall of the NQT year ($d = -0.07, p < .10$). By the spring, there were no differences between treatment and control group NQTs in these two dimensions of classroom quality.

Research Question 3: Impacts on Student Outcomes

Impacts on student outcomes were assessed at the end of the NQT year. As shown in Table 4, there were no impacts on the student outcomes that were assessed.

Research Question 4: Head Teacher Training

Impacts of the head teacher training were assessed for all NQT-spring outcomes (follow-up 3). No impacts were detected on any outcome, indicating that the Head Teacher training did

not affect the teaching practice of NQTs trained from the treatment group.

Discussion

This paper presents results from a longitudinal impact evaluation of a pre-service kindergarten teacher training program designed to support implementation of Ghana's national kindergarten curriculum. The results inform the question of how to improve educational quality and learning outcomes in pre-primary education in a country with free and universal pre-primary education and with the second highest ECE enrollment rates in SSA (UNESCO, 2015). While the government has concluded that the kindergarten curriculum is sound (GES, 2012), in reality, what will transform teachers' use of the curriculum to be effective practitioners will be the extent to which they are effectively trained and supported to use it. The findings suggest that there is potential to transform teaching practice through pre-service training.

The FTTT program aimed to provide such training and support for student-teachers training to be full-time kindergarten teachers. The program had mixed impacts and did not translate in to learning outcomes for the students of Newly Qualified Teachers trained in the program. More specifically, the program significantly changed teachers' professional well-being, resulting in increased motivation and sense of personal accomplishment, areas identified as critical to transforming teaching and learning in Ghana (Agbenyega, 2017; Akyeampong & Lewin, 2012), but also decreased job satisfaction. In addition, the program changed teachers' knowledge about developmentally appropriate instruction for pre-primary classrooms, in line with the KG-specific pedagogy supported by the national curriculum. These changes lasted beyond the intervention year, as teachers were placed as full-time NQTs, but faded with time. The findings also indicate that NQTs continued to implement elements of the curriculum, though the extent to which they did so relative to the control group declined over time. The decline in

NQTs' implementation of structural elements of the curriculum (e.g., activity centers, clean water for all children) could be due to teachers not having adequate supplies or materials in their placement schools.

Inadequate supplies, however, do not explain the reduced impacts in use of process-oriented activities to support learning specified in the curriculum's KG-specific pedagogy (e.g., using songs and activities to facilitate learning, using child-led learning activities). These results indicate that more supports are needed during the first year of full-time teaching to successfully implement the pedagogical practices from the training year. Anecdotal evidence indicates that some head teachers discouraged teachers from using the KG-specific pedagogy because they did not know how to evaluate teachers on these methods. The head teacher training tested in this program was designed to address precisely this issue of head teacher support. Yet it was not effective in changing teaching practices or improving student learning outcomes, indicating that a different approach to training head teachers and creating an enabling environment for NQTs is needed.

Impacts on measures of teacher-child interactions, considered the "driver" of student learning outcomes (Pianta et al., 2005), also showed that while teachers implemented more child-led activities, they used less support for student expression and positive emotional support and behavior management techniques, and that all impacts on classroom processes declined with time. Teachers may need specific training in how to support student expression during child-led activities, as these two concepts are not mutually exclusive. This finding may also be an artifact of the way teacher-child interactions were measured. Teachers were videotaped teaching a lesson for 30–45 minutes at one point in time during each wave of data collection. Thus, these findings pertain only to this brief observation period. It would be interesting and useful to either observe

multiple class periods over the course of a few weeks or to assess practice over the course of an entire school day with each teacher. Understanding if / how these impacts on interactions with students and pedagogical practices change if measured for longer periods of time is worthy of investigation.

Alternatively, the decline in effect sizes in classroom processes with time may point to fadeout. This suggests that teachers may need ongoing training and reinforcement beyond the student-teaching year. Additional research is needed on how to improve teachers' pre-service training experiences in ways that transform longer term teaching practice. Perhaps most importantly, none of the changes observed translated in to learning gains for the students of NQTs. This could be because the theory of change was incorrect, or because impacts on the proposed mediating processes, which faded with time, were not large enough to induce change in the more distal outcome of student learning. Importantly, impacts on students in FTTT schools during the student-teaching year, when impacts on mediating processes were largest, were not assessed in this study.

Finally, while not presented in the results section, 25 teachers in this study were placed in primary school classrooms. I examined how placement in a primary classroom (versus a KG classroom) moderated treatment impacts, and find significant differences in treatment impacts were found across a range of outcomes. These analyses indicated two patterns of results: (a) impacts on classroom instructional practices and ECE knowledge were concentrated in teachers placed in KG classrooms, and (b) impacts on professional well-being were larger for teachers in primary classrooms. This points to the lack of coordination in the placement process, and the importance of ensuring alignment between teacher training and their placement classrooms.

While the number of educational intervention impact evaluation studies in low- and

middle-income countries has risen exponentially over the past decade (Conn, 2017), teacher training and professional development interventions have focused almost exclusively on in-service training. A recent meta-analysis on effective educational interventions in SSA found that in-service programs that alter teaching pedagogy and classroom instructional techniques had the largest effects on student learning outcomes (Conn, 2017). Developing a more systematic, rigorous research base on effective pre-service experiences for teachers in LMICs, and SSA specifically, is a critically needed area of future research.

Research on the pre-service training system after reforms in Ghana in the 1990s found that positive attitudes toward teaching deteriorated from the beginning to end of the student-teaching year, and even more so as student-teachers become NQTs for primary school teachers. When asked to speculate about their career in 5 years, over 80% indicated they would most likely have gone on to further studies, and only 3% thought they would still be teaching in a primary school (Akyeampong & Lewin, 2002). This implies that additional professional development efforts are needed to support NQTs and full-time teachers. Indeed, pre-service training alone does not ultimately improve student achievement. Rather, content-focused, in-service professional development and teaching experience positive affect student learning outcomes (Harris & Sass, 2011). Thus, pairing pre-service training with well-aligned, in-service training may be key to ultimately improving student learning outcomes. Since it is unlikely that more resources will be devoted to pre-service training, a more realistic approach could be to coordinate the timing and content of professional development opportunities provided by the National Teaching Council in the MoE. A recent study in Ghana with kindergarten teachers found that in-service training paired with coaching and monitoring by district circuit supervisors and ECE coordinators impacted both classroom quality and student learning and social-

emotional outcomes (Author). This suggests that district education officers could be an important source of ongoing support for NQTs and full-time teachers, and possibly also for head teachers.

When analyzing impacts of any educational intervention, cost is critical to understand the feasibility of implementation at scale. Cost estimates for the FTTT program include costs for each model practice classroom, which can host up to 4 student-teachers, of approximately 6500 Ghana cedis (the equivalent of ~1500 USD), and an additional 414 Ghana cedis (~93 USD) for training and mentorship of each student-teacher. Given the results of this evaluation, additional resources would likely need to be deployed during the NQT year to reduce the fadeout of impacts and potentially translate to impacts on student learning. Costs to support NQTs, including a “starter pack” of teaching and learning materials and a refresher training, are estimated to be 1300 Ghana cedis (~292 USD).

Limitations and Conclusions

These results must be interpreted within the limitations of the study. First, the participants in this study were graduates from one college of education in one region in Ghana. Results cannot be generalized to teachers graduating from other colleges of education, or from the university system in Ghana. Second, while student-teachers were randomized to spend their training year in either a FTTT school or a control school, the schools selected to implement the FTTT program were not randomly assigned. Schools had to be deemed sufficiently ready to incorporate the FTTT program, both in terms of facilities and receptiveness of the head teacher and kindergarten teachers. As a result, the impacts of the FTTT program cannot be disentangled from the differences between schools ready and not ready to implement the program. Third, teachers were observed for only one class period at each wave. Not having a more comprehensive assessment of the teaching and classroom context is a major limitation of this

study's ability to assess impacts on teacher-child interactions. Finally, the internal reliabilities of the scales used to measure classroom quality were low, potentially limiting our ability to accurately capture impacts on classroom processes.

Nonetheless, this study provides lessons and guidance that can support countries as they strive to fulfill Sustainable Development Goal 4 on quality education, and specifically Target 4.2—that every child receives one year of high quality pre-primary education (United Nations, 2015). The findings show that supplemental pre-service training during the student-teacher placement year can induce large changes in teachers' motivations and perceptions about kindergarten education, but that additional support during the first placement year is needed for teachers to successfully translate their knowledge into improved practice and, ultimately, improved student learning outcomes. Ghana's Ministry of Education is working to improve and align its pre-service teacher training system nationally through the T-TEL initiative (Ministry of Education, 2017). This study suggests that for improvements to have lasting impacts on the teacher workforce, providing ongoing in-service support and professional development opportunities will be important. Given the low learning levels of primary and secondary students in SSA, and in Ghana specifically (Sandefur, 2016), these issues extend beyond the pre-primary sector and have implications for improving educational quality and student learning across education levels and countries.

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Table 1. Summary of data collected at each round

	Baseline (Jun 2015)	Follow-up 1 (Jun 2016)	Follow-up 2 (Nov–Oct 2016)	Follow-up 3 (May–Jun 2017)
Demographics	X			
Implementation of curriculum		X	X	X
Early childhood education knowledge			X	X
Teacher–child interactions		X	X	X
Professional well-being		X	X	X
Student outcomes			X	X

Table 2. Baseline equivalency across treatment and control group student-teachers

	Control	Treatment	<i>t</i> - or <i>F</i> - stat	p-value
	Mean			
Female (%)	100.0	100.0	0.00	1.000
Age (years)	23.2	23.6	-1.46	0.148
Highest level of education completed (%)			1.94	0.163
Secondary school	100.0	100.0		
Diploma	0.0	2.9		
Married (%)	7.8	4.4	0.71	0.401
English language proficiency (%)			1.35	0.510
Fluent	96.4	96.8		
Basic	3.6	1.6		
None	0.0	1.6		
School type preference after training completion (%)			2.67	0.445
No preference	0.0	1.5		
Private	1.5	0.0		
Public	84.9	79.7		
Religious	13.6	18.8		
Literacy knowledge assessment (% correct)	34.1	34.2	0.03	0.981
Sample size (total = 135)	66	69		

Table 3. Impact estimates on curriculum implementation and knowledge, professional well-being, and teacher–child interactions

	B	(SE)	<i>d</i>		b	(SE)	<i>d</i>		b	(SE)	<i>d</i>	
	Follow-up 1 (Student-teachers)				Follow-up 2 (NQT-Fall)				Follow-up 3 (NQT-Summer)			
<u>Implementation of curriculum^a</u>												
Materials	4.78	(0.59)	2.40	***	0.77	(0.08)	0.38	***	1.92	(0.10)	0.82	***
Activities	1.83	(0.33)	1.14	***	0.54	(0.07)	0.32	***	0.49	(0.07)	0.32	***
<u>Early Childhood Education Knowledge^b</u>												
Developmentally appropriate practice	--	--	--		0.16	(0.01)	0.44	***	0.18	(0.02)	0.49	***
Supporting child social-emotional needs	--	--	--		0.42	(0.03)	0.64	***	0.25	(0.02)	0.59	***
Family-sensitive practice	--	--	--		0.13	(0.03)	0.18	***	0.28	(0.03)	0.39	***
<u>Teacher professional well-being^b</u>												
Motivation	0.12	(0.11)	0.23		0.11	(0.02)	0.23	***	0.06	(0.03)	0.10	*
Burnout	0.36	(0.03)	0.34	+	-0.05	(0.04)	-0.05		-0.09	(0.04)	-0.09	*
Job satisfaction	-0.05	(0.07)	-0.11		-0.04	(0.02)	-0.10	*	-0.15	(0.02)	-0.37	***
Personal accomplishment	0.36	(0.14)	0.42	*	0.20	(0.04)	0.19	***	0.30	(0.04)	0.31	***
<u>Teacher-child interactions^a</u>												
Child-led learning	0.54	(0.12)	0.90	***	0.14	(0.02)	0.36	***	0.05	(0.02)	0.11	*
Supporting student expression	-0.31	(0.13)	-0.53	*	-0.04	(0.02)	-0.07	+	0.01	(0.03)	0.02	
Emotional support and behavior management	-0.01	(0.08)	-0.02		-0.04	(0.02)	-0.08	+	0.03	(0.03)	0.06	

*** $p < .001$, ** $p < .01$; * $p < .05$, + $p < .10$.

^a Sample size = 129 teachers placed in KG or primary 1-3 classrooms.

^b Sample size = 135 teachers placed in KG, primary, or JHS classrooms.

Estimates at follow-up 2 and follow-up 3 derived from 20 multiply imputed datasets.

Covariates for student-teacher regressions include: teacher age and close family nearby.

Covariates for NQT regressions include: teacher age, close family nearby, a dummy indicator for schools with more than 1 NQT, a dummy indicator for if the teacher is in a primary level class, and country region.

Table 4. Impacts on student outcomes at the end of the school year

	b	(SE)
	Follow-up 3 (NQT-Summer)	
Early numeracy	-0.001	(0.016)
Early literacy	-0.020	(0.020)
Social-emotional	0.003	(0.016)
Executive function	-0.006	(0.011)
Approaches to learning	0.060	(0.059)
Sample size = 1,604		

Note. Impacts on student outcomes assessed only for teachers placed in KG and primary 1 classrooms ($N = 110$ teachers).

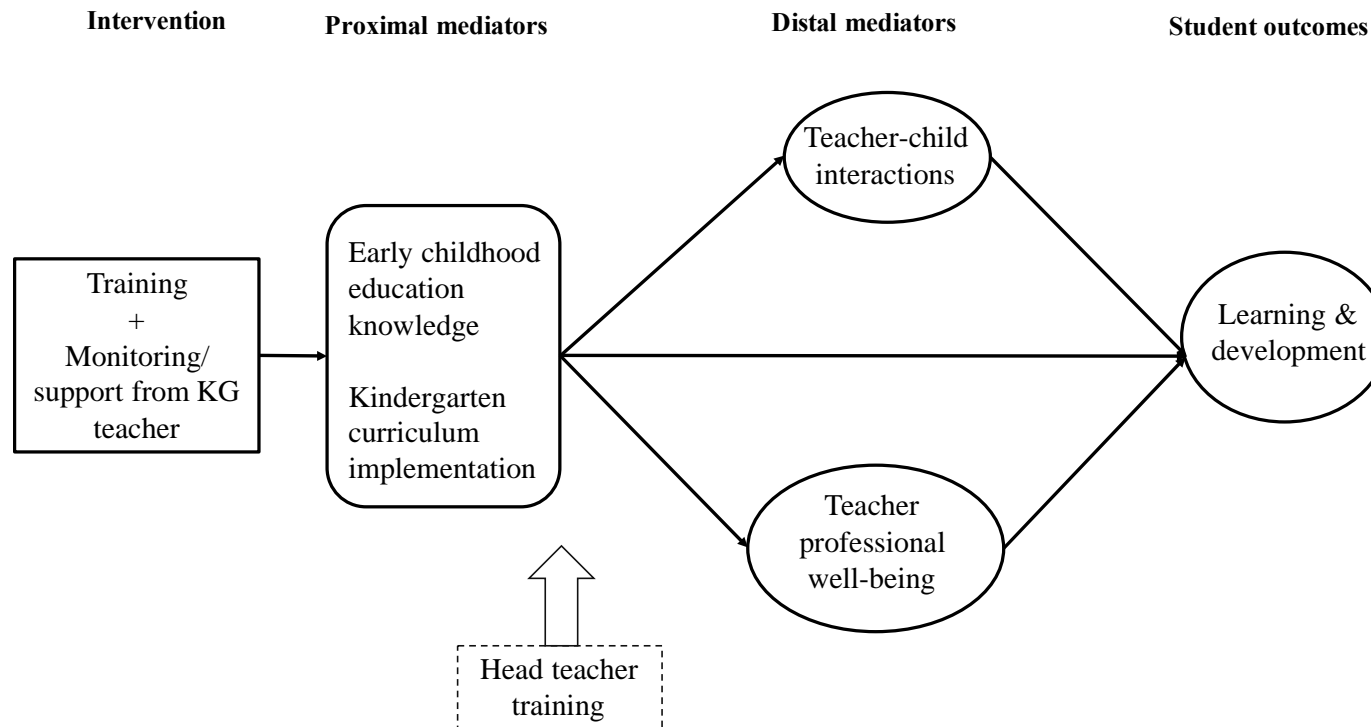
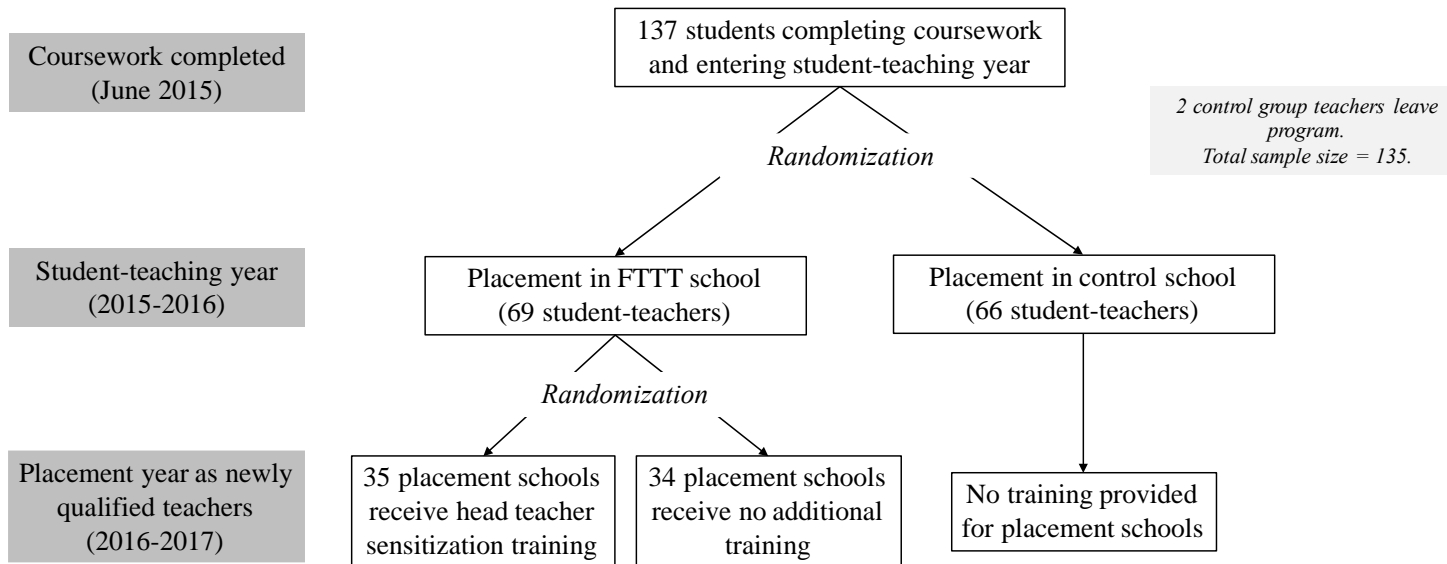
Figure 1. Theory of change

Figure 2. Research design, timeline, and sample



Appendix Table 1. Sample sizes and missing data at each wave

	Follow-up 1 (Student-teachers)		Follow-up 2 (NQT-Fall)		Follow-up 3 (NQT-Summer)	
	Present	Missing	Present	Missing	Present ^a	Missing
Treatment	69	0	67	2	69	0
Control	66	0	62	4	62	4
Total	135	0	129	6	131	4

^a Three video recordings of classroom observations could not be opened due to the files becoming corrupt. Thus, for classroom observations only at follow-up 3, an additional 2 treatment teachers and 1 control teacher are missing (i.e., 67 treatment teachers and 61 control teachers have classroom observation data at follow-up 3).

Appendix Table 2. Treatment impact estimates with no covariates

	b	(SE)		b	(SE)		b	(SE)	
	Follow-up 1 (Student-teachers)			Follow-up 2 (NQT-Fall)			Follow-up 3 (NQT-Summer)		
<u>Implementation^a</u>									
Fidelity structure checklist	4.78	(0.59)	***	0.79	(0.08)	***	1.95	(0.09)	***
Fidelity process checklist	1.82	(0.34)	***	0.53	(0.07)	***	0.55	(0.06)	***
<u>Early Childhood Education Knowledge^b</u>									
Developmentally appropriate practice	--	--		0.17	(0.01)	***	0.21	(0.01)	***
Supporting child social-emotional needs	--	--		0.40	(0.03)	***	0.29	(0.02)	***
Family-sensitive practice	--	--		0.17	(0.02)	***	0.28	0.03	***
<u>Teacher professional well-being^b</u>									
Motivation	0.13	(0.12)		0.08	(0.02)	***	0.09	(0.02)	***
Burnout	0.37	(0.20)		-0.05	(0.04)		-0.06	(0.04)	
Job satisfaction	-0.05	(0.07)		-0.05	(0.01)	***	-0.05	(0.02)	***
Personal accomplishment	0.37	(0.15)	*	0.15	(0.04)	***	0.30	(0.04)	***
<u>Teacher-child interactions^a</u>									
Child-led learning	0.52	(0.11)	***	0.10	(0.02)	***	0.02	(0.02)	
Supporting student expression	-0.31	(0.13)	*	-0.05	(0.02)	*	0.12	(0.02)	***
Emotional support and behavior management	-0.02	(0.09)		-0.02	(0.02)		0.08	(0.02)	***

*** $p < .001$, ** $p < .01$; * $p < .05$, + $p < .10$.

^a Sample size = 129 teachers placed in KG or primary 1-3 classrooms.

^b Sample size = 135 teachers placed in KG, primary, or JHS classrooms.

Estimates at follow-up 2 and follow-up 3 derived from 20 multiply imputed datasets.