Supporting Mathematics Education in Rural Early Childhood Centers

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Abstract

This paper presents the model and preliminary results of an investigation into the effects of professional development for teachers in the area of early childhood mathematics. The purpose of this two-year project is to improve the confidence, knowledge, and skills of rural early childhood educators to provide effective and ongoing instruction to establish a solid mathematical foundation for young children. The project focuses on providing high quality professional development which includes ongoing embedded support to a small cohort of early childhood educators in rural early childhood centers. Initial classroom observations were conducted to get a better understanding of the daily structure and routine of the classroom, materials available, and evidence of mathematics instruction. Self-report surveys provided data focused on participant attitudes, confidence, beliefs, and classroom practices. Anecdotal notes from an instructional coach and feedback from participant satisfaction surveys yielded additional data. Comparison of baseline and Phase One data indicated a positive shift in the attitudes, confidence and beliefs of teacher participants and a reported increase in the amount of mathematics instruction presented in the classrooms. There was also a high level of satisfaction with the monthly workshops and instructional coaching along with comments and suggestions for improvement.

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The importance of math learning experiences in early childhood as a foundation for future educational success has been well documented (Clements, Sarama, & DiBiase, 2004; NCTM, 2013; NRC, 2009). Research also shows that the provision of high quality professional development to early childhood and elementary teachers can improve the mathematics achievement of their students (Lee, 2010; Yoon, Duncan, Silvia, Scarloss, & Shapley, 2007). In the United States, professional development (PD) opportunities are most readily available to teachers in large, public school districts and is often focused on kindergarten to 8th grade learning. In rural areas where achievement is impacted by low socio-economic issues (Adams, Zaslow, & Tout, 2007; Lee & Burkam, 2002), much early childhood education is provided in small, independent or religious settings for which few PD opportunities exist or can be afforded with limited budgets. The opportunity for content-focused and pedagogical learning for teachers in these centers is rare. The researchers for this project work at a university located in a small, rural community in southern Illinois in the United States. Within the geographic region surrounding the university, there are many low-income, rural communities with limited access to resources. Independently operated early childhood centers are located within these communities that serve young children and their parents, positioning the university well as a provider of sustained professional development focused on mathematics.

Overview of the Project

The purpose of this two-year project is *to improve the confidence, knowledge, and skills of rural early childhood educators to provide effective and ongoing instruction to establish a solid mathematical foundation for young children.* The project focuses on providing high quality professional development (as defined by Darling-Hammond, Hyler, & Gardner, 2017; Winton, Snyder & Goffin, 2016) to a small cohort of early childhood educators in independently operated early childhood centers. The professional development model used for this project includes monthly workshops held on campus with all participants, as well as, embedded professional development in the early childhood classrooms. Workshops focus on improving teachers' attitudes and beliefs about mathematics, active engagement of teachers in learning content and pedagogy critical to early childhood mathematics instruction, and introduction of materials and activities to be used in the classroom. In addition to the monthly workshops, an instructional coach visits each classroom twice a month to provide modeling and support on the effective use of strategies and materials. The overall goals of the grant are to provide high-quality professional development to early childhood educators in small, rural facilities in order to 1) increase participants' pedagogical content knowledge in mathematics; 2) improve participants' confidence and attitude regarding math-teaching ability; and 3) increase participants' use of effective pedagogical strategies and methods in teaching mathematics.

Professional Development Model

The READY 4 Math project is founded in the principles of high quality professional development described by Darling-Hammond, Hyler, and Gardner (2017). These authors found that effective professional development involves a focus on content, active learning, collaboration, modeling of effective practice, coaching, and time for reflection over a sustained period (2017). The Ready 4 Math professional development model involves all of these elements over a period of two school years. Concepts and pedagogy appropriate for early childhood mathematics makes up the content focus of the project. Participants learn this content through engaging in discussion and activities at monthly workshops where effective practices are modeled by project investigators. A veteran early childhood educator with expertise in instructional coaching supports the use of the newly learned strategies through visits to each classroom twice per month. Participants share and reflect upon their experiences when they return to the next workshop. This paper reports on the experiences and results of the first four-month semester of project implementation, referred to as Phase One of the project.

Methodology

Participants

Early childhood centers for this project were purposefully selected based on three criteria. The first overarching criteria was geographic location. Only centers in small, rural districts were considered, due to the lack of resources in those areas. Designation as a high needs school district, based on annual test scores of the district and socioeconomic level, was the second criteria. The rationale for this requirement was to help increase the foundational knowledge of young children before they enter the K-12 school system. The final requirement was that the center had to be a non-public school facility. Very few professional development opportunities exist for independently operated early childhood centers, so a need was evident. Once centers were identified, the directors were contacted to determine their interest in participating in the project. This selection process resulted in seven participating centers.

Once the centers were established, participants were chosen on a voluntary basis. Any early childhood educator who expressed an interest in the professional development and was willing to commit to the participation guidelines was given the opportunity. This resulted in seven participants for the project, all Caucasian females. Level of education varies among the participants from some college coursework to completed associate's or bachelor's degrees. One of the teachers holds a state credential in early childhood, and one indicated prior professional development in early childhood mathematics. Participating teachers have early childhood teaching experience from a range of less than one year to more than ten years. Average class size for these teachers is 18 students ranging in age from three to five years old. All but one of the teachers works with the students five days per week. Each participant receives $1,000 for each year of participation in addition to all of the materials used in the workshops.

Instrumentation

The variety of goals for the project necessitates a varied approach to assessing the intended outcomes. After setting project goals, a broad search of early childhood mathematics literature was conducted to identify existing instruments with potential for use in this study. Despite the importance of this work, only a few validated measures exist for use in assessing early childhood mathematics outcomes. Of those available, the most appropriate were selected for use in providing insight into the outcomes of each of the project goals, as illustrated in Table 1.

Table 1

*READY 4 Math Project Goal, Outcomes, and Assessment Instrument*s

Project Goal: To improve the confidence, knowledge and skills of early childhood educators to provide effective and ongoing instruction to establish a solid mathematical foundation for young children.	
Outcome	**Measure**
1. Early childhood educators will show an increase in mathematics pedagogical content knowledge.	Teacher Practices Survey
2. Early childhood educators will exhibit greater confidence and a more positive attitude regarding their ability to effectively teach mathematics concepts.	Attitudes, Behaviors, and Confidence in Early Mathematics (ABC-EM)
3. Early childhood educators will demonstrate an increase in effective pedagogical strategies and methods in mathematics.	Classroom observations, coaching notes and Teacher Practices Survey
4. To deliver high quality, embedded professional development to early childhood educators in small, rural facilities.	Project Feedback Survey

To ascertain strategies employed by participants in teaching math, the Teacher Practices Survey, a slightly shortened version of the CME Foundation Math Survey (CME Group Foundation, n.d.), was utilized. This seventeen-item Likert-style survey asks teachers to respond whether they never, rarely, sometimes, or often use eight different high impact teaching practices. Additional prompts ask participants to indicate the extent to which they address nine different key concepts in math: counting, data analysis, measurement, number sense, operations, patterns, sets, shapes, and spatial relationships in their teaching. An option of "unable to answer" was provided in case participants were not familiar with the practice or concept described in any given item.

In addition to teacher practices, investigators seek to analyze shifts in participant attitudes toward math and the teaching of mathematics in their classrooms which occur over the life of the project. Investigators are interested in how teachers view mathematics and mathematics instruction as well as their confidence in effectively working with students to improve their mathematical ability. To gather this data, investigators requested and were granted permission to utilize the Attitudes, Beliefs, and Confidence in Early Mathematics (ABC-EM) measure designed by Chen and McCray (2013). Reliability for this instrument is reported at the .94 level using Cronbach's Alpha. This survey consists of twenty-eight statements related to mathematics, mathematics instruction, and teacher confidence in both their own mathematics competence and the ability to teach it effectively. Responses are indicated on a scale from zero to 10.

Prevalent among the results of our search for related instruments was the Classroom Observation of Early Mathematics-Environment and Teaching (COEMET) developed by Clements & Sarama (2007). Unfortunately, the required training for use of the instrument was not available within the implementation timeline. Another promising instrument, the Pedagogical Content Knowledge – Early Math (PCK-EM) Interview (McCray & Chen, 2012) was cost prohibitive. Instead, the authors relied upon previous experiences in conducting classroom observations to develop a new protocol for use in this project. The paper/pencil observation form developed is used to record data on interactions between the teacher(s) and student(s) and student-to-student, including notation on the type of interaction, how it was initiated (and by whom), and the length of the interaction.

An important aspect of the project is the embedded professional development component. As noted previously, the instructional coach attends the monthly workshops and visits each classroom twice a month. During the visit, the coach records anecdotal notes on the classroom activities, suggestions, and critical feedback. Notations are also made on the nature of the coaching provided to the teacher and topics of discussion. These notes are recorded on a form developed by the instructional coach and discussed with the teacher following the visit.

Finally, the investigators were not only concerned with the stated outcomes, but also with participants' perceptions of the experience. Teachers are participating voluntarily in after-work meetings, as well as, welcoming an outsider into their classroom. Therefore, it is important that the investment of valuable time and energy is considered worthwhile and meaningful. To evaluate this outcome, a feedback survey was developed for use at the end of each semester which focuses on the three main elements of the project: monthly workshops, provided materials, and instructional coaching. Participants utilize a four-point scale to rate each project element on five different criteria and provide optional comments below each. This feedback instrument will be used again at the end of each phase of the project.

Implementation and Data Collection

READY 4 Math is a two-year project consisting of monthly workshops and embedded professional development in the classroom. An initial, kick-off meeting was held one month prior to implementation to make introductions, finalize details, revisit expectations and collect baseline data. The project then began

in the following month of January 2018. The phases of the professional development are broken down into four semesters, not including summers.

The project began with a meeting attended by all participants to establish and support a professional learning community. This meeting served as an opportunity for participants to become familiar with the host site, instructors, coach, and one another. In addition, instructors modeled a sample activity to introduce the approach and tone of future workshops.

Initial data related to participant background and experience, current practices of teaching math, and attitudes and beliefs related to mathematics and its teaching were collected via self-report surveys. Surveys were administered in paper-pencil format at the project kick-off meeting one month prior to the project activities beginning. Participant data collected included basic demographics along with classroom characteristics (number of students, hours of class per week, etc.) and previous experience with early childhood teaching, workshop, and professional development, as included in the description of participants above.

The Teacher Practices Survey was also completed by all participants at the outset of the project and the end of the first semester. Subsequent administrations will be made at the project mid-point and following the last month of participation. The ABC-EM was administered prior to the project start, at the end of the first semester, and will be administered twice more across the project, at the end of each year.

To establish a baseline of the classroom environment, investigators made initial observation visits to each classroom, recording teacher-student and student-student interactions over a 20-minute period using the observation form. Observations were arranged for a time of day that was not designated for snack or nap, but was otherwise determined on a convenience basis. Observations will be conducted again each year of the program which will result in data collection from each classroom at the beginning of the project, after the first year, and following project completion.

The project began in earnest with the first full workshop held in January 2018. Each workshop had a theme through which participants explored specific mathematical concepts and pedagogy through hands-on activities. Pedagogical strategies were introduced, discussed, and modeled using developmentally appropriate materials which were then provided to participants for continued use in their classrooms. The focus of the workshops is to expose the early childhood educators to effective, research-based teaching strategies to increase their confidence level and effectiveness in teaching mathematics. An additional focus is to demonstrate how foundational mathematics concepts can be easily integrated into all aspects of their daily activities, such as story time, gross motor activities, centers and snack time.

In the time between monthly workshops, an instructional coach visits each educator twice in their classroom to provide individual support. The instructional coach is an experienced early childhood educator with expertise in teacher mentoring. Coaching involves modeling strategies with the children, discussing ideas and concerns, and making suggestions for improvement. The first phase of workshops and coaching continued through the end of May 2018 and will resume the following fall. Therefore, the initial PD phase consisted of four monthly workshops held on the university campus and as many as eight coaching visits per participant.

At the end of the first semester, a workshop survey was completed by all participants to acquire feedback on their satisfaction with the grant, materials, workshops and coaching. This survey will be administered at the end of each phase of the project to inform planning for each subsequent phase.

Initial Results

Classroom Observations

The purpose of the initial observation of each classroom was to gain insight into the settings of each of our participants' classrooms, including student population, resources, and classroom learning environment to inform decision-making as the project began. This also provided insight into the overall classroom organization and teaching style of each participant. Toward this end, the observation instrument was found useful, but not comprehensive in terms of supporting documentation of the classroom environment. Follow-up discussions focused mainly on the similarities and differences between the settings. Two classrooms stand out from the rest as extremes of classroom structure; one is the only parochial pre-school situated within a K-8 school building, and the other is an independent center, like the rest of the sample. The classroom environment in the parochial setting is very structured and academically focused. Students were observed in whole class instruction, using worksheets and interacting with the teacher as a group as one would find in a school setting. At the other end of the structure spectrum was a classroom which gave the impression of a play room, where academic goals were lacking, and students were involved in choice activity, with little to no guidance from the teacher or aide other than disciplinary responses to disruptive behavior. Between these two ends of the spectrum are situated the five other centers, which are largely similar in terms of classrooms arranged in centers.

Teacher Practices Survey

Results of the initial administration of the Teacher Practices Survey (see Table 2) showed a range of responses as would be expected from a group of teachers with a diverse background of experience related to teaching early childhood mathematics. Scores were generally lower in the frequency of use of high impact teaching practices (e.g. talking with students about ways to solve math problems) than in the extent to which individual math concepts, such as counting and measurement, were addressed in the classroom. For instance, the average frequency with which an individual teacher used high impact practices prior to the project start was a 1.1, indicating “sometimes,” while that same teacher scored an average of 2.1, or “often,” in terms of the extent to which she addressed the nine key math concepts. We were not surprised to find that teachers reported addressing most “often” (average score of 2.5 or above) were counting (X =3.0), shapes (X = 2.86), patterns (X=2.71), and number sense (X=2.57). These are concepts more commonly addressed than data analysis, measurement, number sense, operations, sets, and spatial relationships, which teachers reported addressing to a lesser extent (means ranging from 1.29 to 2.0) in the pre-project survey.

In each case, teachers showed an increase in their use of the high impact pedagogical strategies at the end of the first semester of the project when compared to initial responses. The average gain in scores (ranging from zero to three) was 0.58 from an initial average score of 1.95 to 2.54, indicating a shift, on average, from using the identified instructional strategies less than “sometimes” to more than “sometimes, and approaching “often.” Increases of 0.50 or more were seen in six out of the eight items, with the greatest gains indicated in Item 1 (talk to students about ways to solve math problems, increase of 0.86); Item 7 (use models to represent problems and/or solutions, increase of 0.76); Item 3 (ask your students to help each other solve math problems, increase of 0.72); Item 4 (have students work together in small groups on math-related activities, increase of 0.71); and Item 8 (use charts and/or graphs to display data, increase of 0.67). The smallest average gain was shown in Item 5 (use math manipulative learning tools with students), with an average increase of 0.15. This item was the highest score on the initial survey with an average response of 2.71.

Six of the seven participants also showed an increase in the average extent to which they addressed the nine math concepts with their students. The average individual gain from January to May was 0.43, also on a three-point scale. Greatest gains were indicated in three areas: Operations (mean gain of 1.00), Spatial Relationships (mean increase of 0.86), and Data Analysis (mean increase of 0.85).

Table 2
Teacher Practices Survey Results

TEACHER PRACTICES SURVEY				
	Item	Mean Initial Score	Mean Phase One Score	Mean Difference
Item #	How often do you…			
1	Talk to your students about ways to solve math problems?	2.14	3.00	0.86
2	Ask your students to tell you how they solve math problems?	1.71	2.29	0.57
3	Ask your students to help each other solve math problems?	1.71	2.43	0.71
4	Have students work together in small groups on math-related activities?	1.86	2.57	0.71
5	Use math manipulative learning tools with students?	2.71	2.86	0.14
6	Use measurement tools with students?	1.86	2.29	0.43
7	Use models to represent problems and/or solutions?	1.57	2.33	0.76
8	Use charts and/or graphs to display data?	2.00	2.67	0.67
	How often do you... AVERAGE	1.95	2.54	0.59
	To what extent do you address…			
9	Counting	3.00	3.00	0.00
10	Data analysis	1.29	2.14	0.86
11	Measurement	1.71	2.14	0.43
12	Number sense	2.57	2.86	0.29
13	Operations	1.29	2.29	1.00
14	Patterns	2.71	2.71	0.00
15	Sets	2.00	2.43	0.43
16	Shapes	2.86	2.86	0.00
17	Spatial relationships	1.43	2.29	0.86
	To what extent... AVERAGE	2.10	2.52	0.43

Attitudes, Beliefs, and Confidence (ABC-EM) Survey

Initial responses to the ABC-EM were found to be fairly high, with the average of all items falling in the range of the mid-point of five or above (below for the negatively phrased items). The range of average scores on the initial survey was 4.86 to 8.00. The lowest rated statement was "I can easily convert fractions into percentages or decimal numbers." The highest rated statement was "I believe that my pre-service education has sufficiently prepared me to teach mathematics." With regard to the key factors assessed in the survey, Positive Math Attitude and Confidence in Teaching Math, overall initial mean ratings were lower for attitude (X=6.09) than for confidence (X=7.37). Initial and Phase One results of the ABC-EM Survey are presented in Table 3.

The overall range in scores shifted slightly higher in the Phase One results. The new mean range was 4.71 to 8.43. This time, participants rated the same item lowest, but the highest rated item changed to "I have the support I need to teach math well." Mean ratings for both attitude and confidence increased, to 6.30 and

8.13, respectively. This shows a mean increase in ratings of positive math attitude of 6.30, and a mean increase in rating of items related to confidence of 0.71.

Mean increases of over 1.00 resulted for six items, nearly one-fourth of the total survey items. The items of greatest growth were “I am not a math person” (+1.14 recoded); “Even when I try, I don’t teach mathematics as well as I teach many other subjects” (+1.29 recoded); “I am confident in my ability to engage students in mathematics problem solving” (+1.43); I am confident in my ability to help students reason about and prove how they have solved a mathematics problem” (+1.00); “I am confident in my ability to locate resources for preparing exciting and engaging math lessons” (+1.43); and, as mentioned above, “I have the support I need to teach math well” (+1.43).

Mean change in three items decreased, rather than increased, over the first phase. Most interestingly, two of these items ("I can easily convert fractions into percentages or decimal numbers," and "Math was one of my favorite subjects in school.") would be expected to remain somewhat stable, as they relate to teachers' own perceptions of their own math ability. Responses to the statement "Math is my least favorite subject to teach" showed a mean decrease of –0.43 when recoded. All three of these statements showing negative impact are in the attitude section of the survey.

Responses to two items in the survey indicated no change from the initial baseline and the completion of Phase One. Mean scores for the items “I am confident in my ability to connect mathematics learning to other curricular areas” and “Many times in my class I can get through to even the most difficult or unmotivated students” were constant at 7.00 and 7.43, respectively.

Table 3

ABC-EM Results

Attitudes, Beliefs, and Confidence (ABC-EM) Survey				
Factor	**Item**	**Initial Mean**	**Phase One Mean**	**Mean Difference**
Positive Math Attitude	I am not a "math person." RECODED	5.71	6.86	1.14
	I have a hard time quickly calculating arithmetic facts in my head. RECODED	5.43	6.14	0.71
	I can easily convert fractions into percentages or decimal numbers.	4.86	4.71	-0.14
	I'm good at looking at numeric data and finding patterns.	6.14	6.43	0.29
	Math was one of my best subjects in school.	5.00	5.43	0.43
	I am good at math puzzles.	6.57	7.00	0.43
	Math is my least favorite subject to teach. RECODED	6.43	6.00	-0.43
	I like doing math.	6.86	7.29	0.43
	Math was one of my favorite subjects in school.	6.86	6.00	-0.86
	Just the word "math" can make me feel nervous. RECODED	7.00	7.14	0.14
	Mean Attitude	6.09	6.30	0.21
Confidence in Teaching Math	Even when I try, I don't teach mathematics as well as I teach many other subjects. RECODED	5.57	6.86	1.29
	I am confident in my ability to...			
	...use a variety of assessment techniques to evaluate students' mathematical learning and progress.	6.86	7.29	0.43

	...translate assessment results into mathematics teaching plans.	6.71	7.00	0.29
	...set appropriate math learning goals for my students.	7.00	7.57	0.57
	...anticipate problems and confusions that students might have with particular math topics or concepts.	6.57	7.29	0.71
	...engage students in mathematics problem solving.	6.57	8.00	1.43
	...facilitate students' communication about mathematics (for example, discussions, questions, and journals).	6.71	7.43	0.71
	...encourage students to represent mathematics in a variety of ways (such as drawings, manipulatives, symbols, and language).	7.29	7.71	0.43
	...connect mathematics learning to other curricular areas.	7.43	7.43	0.00
	...help students reason about and prove how they have solved a mathematics problem.	6.71	7.71	1.00
	...locate resources for preparing exciting and engaging math lessons.	6.43	7.86	1.43
	...many times in my class I can get through to even the most difficult or unmotivated students.	7.00	7.00	0.00
	...further students' math knowledge when they make spontaneous math comments or discoveries.	7.29	8.00	0.71
	I believe that my pre-service education has sufficiently prepared me to teach mathematics.	8.00	8.29	0.29
	I have the support I need to teach math well.	7.00	8.43	1.43
	Mean Confidence	7.37	8.13	0.71

Coach Notes

The instructional coach visited each classroom twice a month to provide support in the form of modeling, observational feedback and addressing any teacher questions or concerns. Ideas were also provided on how to more effectively embed the mathematics instruction into their daily activities within the structure and guidelines of their center. Notes were taken by the instructional coach during and after each visit regarding the types of support activities provided, interactions observed and discussion topics or suggestions provided. These notes were qualitatively analyzed to determine if any themes or patterns existed.

After reviewing the data, it was evident that a wide variety of support activities took place based on experience of the teacher, make-up of the class and culture of the early childhood centers. It was also apparent that the current form for recording activities only required the coach to provide very basic, summary information that did not reflect many of the topics discussed during the meetings between the coach and investigators. Due to this, the results thus far are very limited. Most of the activities logged revolved around three types of interactions: observational notes regarding interactions between the teacher and students, modeling effective strategies and methods, and discussions with the teachers about ideas, issues and questions.

READY 4 Math Feedback Survey

Results of the project satisfaction survey at the end of the first phase of the project showed high levels of participant satisfaction in all three areas evaluated (monthly workshops, provided materials, and instructional coaching). Participants “somewhat” or “strongly” agreed with thirteen of the fifteen items. All seven participants strongly agreed with statements three, four, and six, indicating that the monthly workshops provided information relevant to participants’ teaching and were led by knowledgeable presenters as well as the materials contributing positively to their own individual classroom learning environments. The two items eliciting disagreement pertained to the instructional coaching element of the project. One individual disagreed somewhat with each of the following two statements: “The instructional

coach provided effective feedback to support my teaching" and "The instructional coach met my expectations overall." Further comments indicated that more critical feedback on specific areas for improvement are desired by the coach who is perceived as maintaining a positive approach to her communication.

Discussion

Overall, each form of initial self-reported data indicated generally positive attitudes, beliefs, confidence, and levels of pedagogical content knowledge among participants. Analysis of Phase One results showed growth in almost all indicators, as previously described, and in many cases results were higher than expected, considering the brief time period between initial project implementation and Phase One data collection. Teachers reported significant appreciation of access to high quality materials at no cost. They also rated all elements of the professional development workshops highly.

As described above, participants indicated growth in most of the teacher practices assessed. Areas of the least growth were those in which participants rated their participation the highest in the initial assessment: counting, shapes, and use of manipulatives. While the goal of the project is improvement in teacher practices, the investigators see validity in this result which underscores teachers' current and continued attendance to and utilization of mathematics content and strategies most common in the early childhood setting. Areas of greatest growth, such as the gains seen in data analysis and sets, provide an early indicator that attention given to concepts and teaching approaches in workshops may be yielding the intended results in terms of teaching outcomes, since several Phase One activities focused specifically on these topics. However, this conclusion is countered by the surprising increase in teacher rating of operations, which has not yet been directly addressed in project activities. It is possible that participants gained greater understanding of what is meant by number operations over the course of the semester through interaction with other concepts.

The initial data from the ABC-EM showing positive growth in attitude and confidence in teaching mathematics is encouraging and indicates progress toward our overarching goal. Some items yielded results that were a bit confusing due to the static nature of the item. For example, whether or not math was a person's best or favorite subject in school should not have changed due to the PD provided by this grant. Furthermore, the increase in confidence and ability to teach English Language Learners was also interesting. This topic was not directly addressed in the workshops and there is very little cultural and linguistic diversity in the classrooms of the participants. It is possible that the grant has changed the perceptions of the participants and influenced responses that would be expected to remain constant. These areas will continue to be monitored as additional data is collected in the coming semesters.

Baseline observations conducted provided a glimpse into classroom structure and environment, but were not necessarily helpful in terms of yielding the kind of interactional data as initially intended. Investigators were unable to use the notes for comparative purposes unless the focus was solely on evidence of math instruction and materials during the observations. However, future observations are still deemed valuable to provide a general indication of how materials are being used and math instruction delivered in the classroom.

After analyzing the qualitative data recorded by the instructional coach, it is apparent that a new form for this process is needed. The instructional coach developed the current version based on previous coaching experience and use in other projects. The form currently used has three main areas for recording information, which includes a summary of the teacher, student and coach activities. However, additional information would be beneficial for this project. For example, some more specific documentation about the conversations between the coach and teacher, as well as, more detailed notes on teacher and coach interactions in the classroom. For the next phase of the project, a revised form will be utilized that requires the recording of more specific information to provide a better picture of the specific types of supports provided and each teacher's main areas of concern.

Despite overall positive responses to the PD model and materials, there is always room for growth. Based on Phase One survey results, some minor revisions will be implemented in the workshops and instructional coaching aspects of the project. Each monthly workshop will focus on at least one of the main mathematical concepts for early childhood and include high impact instructional strategies to support participants' overall development in math instruction beyond the specific activities introduced at workshops. In addition, investigators will attempt to challenge participants' own math identities and understanding more extensively through introduction of concepts using higher-level activities before modeling Pre-K level instruction. Furthermore, teachers will continue to be supported through the provision of high- quality instructional materials to enhance their learning environments, with a focus on flexible items with a wide range of utility in supporting instruction. Embedded professional development through instructional coaching will continue, but with a more structured approach. Increased communication will occur before the visits to coordinate coach activities during the visit, such as modeling, student interaction and specific areas of concern. This change is intended to provide more focused modeling and feedback, which will hopefully result in more effective instruction. The feedback form used by the instructional coach was also revised, as described above, to provide more informative data regarding impact of the grant activities.

Summary

Overall, the first phase of this project has been successful in working toward the established goals of improving the confidence, knowledge, and skills of early childhood educators in the area of mathematics instruction. Thus far, there has been no participant attrition and it is the hope that participants will continue throughout the two-year timeline. Feedback gathered from the various instruments will continue to be utilized for instructional and project improvements. As the project moves forward, investigators will concentrate efforts on maintaining the quality of the PD to continue the positive trajectory established during the first phase. The final phase of the project will be completed in fall 2019. Upon completion, all project data will be analyzed, and final results reported.

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