HOW FACILITATORS DEFINE, DESIGN, AND IMPLEMENT EFFECTIVE EARLY CHILDHOOD MATHEMATICS PROFESSIONAL DEVELOPMENT

CÓMO FACILITADORES DEFINEN, DISEÑAN E IMPLEMENTAN TALLERES DE DESARROLLO PROFESIONAL EFECTIVO EN EDUCACIÓN MATEMÁTICA PARA LA INFANCIA

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The call to improve mathematics outcomes for children ages zero to eight requires the development of effective professional development approaches for early childhood mathematics educators. In this study, we looked at how six facilitators created workshops on spatial reasoning, mathematical play, number sense, and theories of learning for early childhood educators. Drawing on Desimone's components of effective professional development, we interviewed these facilitators to understand how they defined a successful professional development and how these definitions aligned with the workshops they created. Interviews showed that all the facilitators in this study designed their workshops to be engaging and interactive for their participants while drawing on the components of coherence, collective participation, and duration.

Keywords: Teacher Education - Inservice / Professional Development, Early Childhood Mathematics, Spatial Thinking, Teacher Knowledge

Introduction and Purpose

Scholars and educators have called for initiatives to improve mathematics outcomes for children ages zero to eight. This calls for effective professional development (PD) to be implemented on ways of thinking about early learning as multimodal, playful, and responsive to the varied sociocultural and linguistic contexts in diverse communities. As PD is crucial in supporting teachers' knowledge and skills that lead to changes in classroom practice (Garet et al., 2001), it is necessary to understand how PD facilitators approach such a vital call. In this study, a nonprofit math and science education center aimed to engender ways of thinking about early math learning through an extensive initiative that partnered with roughly 100 early childhood educational leaders across a Western U.S. state. Central to this initiative were PD workshops led by mathematics coaches who focused on the areas of spatial reasoning, number sense, mathematical play, and theories of learning for children ages 0-8. As the National Council of Teacher of Mathematics (NCTM, 2014) acknowledges the critical role of mathematics coaches in enhancing teacher capacity and positively influencing teacher beliefs, this study aims to understand the goals of the PD workshops established by the mathematics coaches themselves. We asked the following research question:

1. How do experienced facilitators use current research on successful PD to inform their own workshops?

Conceptual Framework

We drew on Desimone's (2009) five dimensions for effective PD as a lens to understand how the PD facilitators structured their workshops. See Table 1 for descriptions of these dimensions.

Table 1: Components of Effective Professional Development

Framework Component	Definition
Coherence	Incorporating participants' individual goals with that of the larger group (Gordon, 2004).
Duration	Follow-up activities and ongoing support in the form of coaching and interacting with colleagues (Ball, 1996).
Content Focus	Textbooks, kits, curriculum units, and other forms of content that focus not only on what the content is, but how it is learned by students (Garet et al., 2001).
Collective Participation	PD that is developed and administered for groups of teachers that come from the same school or department that allows teachers to work together to discuss content, skills, and problems that they experience in their teaching (Garet et al., 2001).
Active Learning	Providing first-hand experiences with the content where teachers can actively participate instead of passively learn through lecture-based sessions (Penuel et al., 2007).

Methods

Study Context and Participants

This study is part of an ongoing project focused on providing and evaluating an early childhood mathematics professional development offered to approximately 100 participants representing 30 educational agencies across a Western U.S. state. For this study, we focused on the workshops designed and facilitated by the PD mathematics coaches during the week-long PD held in July 2019. Participants attended 90-minute sessions about learning theories, culturally relevant pedagogy, spatial reasoning, number-sense tasks, and mathematical play, all centered around enhancing early childhood mathematics education.

Data Collection and Analysis

We conducted one-on-one interviews with each PD workshop facilitator (n=6) after their sessions. Facilitators were asked questions about the professional development workshops they designed for this session, including how they defined a successful PD, how they imagined their participants would implement the content and theory they presented, and what research they based their work on. Using emergent coding (Strauss & Corbin, 1994), we looked to see what themes arose when facilitators defined effective PD and described how they designed their workshops. In particular, we examined ways in which the facilitators' descriptions of their workshops compared or comported with what they described as the components required for a successful PD. This analysis provided insight about the many different evidence-based approaches the facilitators took to create and implement their workshops.

Results

Below we address our findings for the workshops on Mathematical Play, Spatial Reasoning, Theories of Learning, and Number Sense.

Mathematical Play

Peter's session engaged participants in a discussion about the various ways that they play in their own daily lives and asked participants to consider whether "learning" might also be a way to describe these activities. Peter challenged his participants to not think of play and learning as separate ideas,

but as potentially one and the same: "Children develop meaning by interacting with objects and posing problems through play." After some time for group discussion about this idea, Peter presented information on the history of early childhood play. Next, participants were given time to play with non-traditional pattern blocks and reflect on what problems they posed during their play, what mathematics they drew on in their play, and how this playful experience impacted their identity as a mathematics learner.

When asked about what defines a successful PD in his post-interview, Peter specifically mentioned all five components of Desimone's (2009) framework. Peter explained the importance of creating PD that engages participants in the kinds of experiences they would do with their own learners. Drawing on Desimone's framework for content-focused active learning, Peter anchored the workshop by drawing on participants' experiences with play, which resonates with creating a coherent PD experience. Peter described a practice-focused approach to support participants in implementing strategies in their own contexts and highlighted the importance of treating participants as professionals, drawing on play as a way to enact a more equitable approach to PD. Lastly, Peter described learning math through play as a way to promote attitudes and dispositions toward mathematics that are playful and fun rather than intimidating or unapproachable.

Spatial Reasoning

At the beginning of their session on spatial reasoning, Shane and Ana encouraged participants to think about how they got from the parking lot to the room where the session was held. Then, participants created written instructions or a visual sketch for traveling the distance. Shane and Ana defined spatial reasoning as the concepts, tools, and processes involving the location and movement of objects and persons, either mentally or physically, in space; they also introduced Piaget's three mountain task and the importance of spatial reasoning for mathematics learning. Next, participants engaged in nine different spatial reasoning activities, including Piaget's three mountain task and water level task, mental rotation visualization tests, and mental folding. Participants engaged in a group discussion about the challenges they encountered when engaging in these activities and whether their view of the importance of spatial reasoning had changed.

In their post-PD interview, Shane and Ana explained that they wanted participants to leave with an expanded understanding of spatial reasoning. Furthermore, Shane and Ana wanted to connect what they presented in the spatial reasoning session to other sessions that were offered at the week-long institute. In this way, Shane and Ana's session aligned with Desimone's components of content focus and active learning. Finally, Shane and Ana hoped that participants would provide similar learning experiences for the teachers they worked with. In order to encourage this post-PD implementation, Shane and Ana discussed the need to support their participants in applying what they learned in their own contexts, whether they worked with infants/toddlers or preschool-aged children.

Theories of Learning

Sam and Evelyn began their session by engaging participants in a discussion about what it feels like to be a learner, "to have the participants experience describing an object as a child would. We wanted the participants to put on the hat of a learner." In order to mirror what it is like to develop a concept as a child, they introduced an unfamiliar word: "Tutusa". Tutusa was a made-up concept the PD facilitators developed that represented objects that weighed the same but looked different. Sam and Evelyn gave a few visual examples and non-examples of Tutusa, then provided cubes of different sizes, color, and weight, as well as measurement scales so that participants could work in small groups to determine the meaning of Tutusa. At the end of the session, each group was asked to *nonverbally* share what they believed Tutusa meant. Nonverbal communication was an added challenge to engage participants in communicating meaning without words, through gesture or movement.

In their post-PD interview, Sam and Evelyn stressed the importance of creating an engaging and interactive activity by drawing on the backgrounds, knowledge, and needs of their participants. In this way, they placed an importance on coherence throughout their session. Sam and Evelyn also highlighted how a successful PD needs to include regular follow-up and ongoing support for all participants. As Evelyn explained, the follow-up is "just as significant as the institute itself, if not more." These responses align directly with Desimone's components that attend to duration, collective participation, and active learning.

Number Sense

Becky's session on number sense engaged participants in recognizing developmental progressions for various number concepts, such as number word sequence, one-to-one correspondence, and strategic reasoning. Becky showed six different videos of preschool-aged children reciting number word sequences to twenty, for example, and asked participants to look for cues that could provide insight in the child's counting processes. She then provided participants with concrete "what to do" strategies to support children in various stages of development. For example, for a child in an early stage, she highlighted how teachers could support children in developing one-to-one correspondence. Becky's goals for the session included wanting to engage participants in thinking about how young children come to think about numbers and number concepts. Becky acknowledged that "counting is a complex learning experience," so she wanted to support participants in thinking about how young children "make connections to place value" or other such concepts.

In her post-PD interview, Becky positioned herself as a learner, taking a reflexive stance towards her own facilitation practices. She stated that she not only hoped participants learned from the session–ideally, she intended to learn from participants as well. She wanted to draw on the expertise in her audience to help everyone in the room "understand more deeply and connect to other learnings they have had." In preparing her session, Becky explained, she developed an agenda but would likely end up changing her plan depending on the identities and experiences of her audience. In reference to Desimone's framework, Becky's responses align with both coherence and active learning; she activated participants' prior experiences and leveraged these for learning in her session.

Discussion and Conclusion

Overall, participants stressed that a successful PD includes follow-up coaching and ongoing support, both of which are consistent with the importance of duration in effective PD. In addition, the PD facilitators created workshops that were engaging for their participants, drawing on the active learning component. We argue that the four sessions presented here are exemplary cases of rigorous and ambitious PD aligned with current research and grounded in the needs of the practitioners in the room. This report reveals important insights about how experienced PD facilitators approach their practice to provide a professional learning event that seeks to go beyond the week-long institute itself.

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