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Supplement Article

Developing a Phonological Awareness Curriculum: Reflections on an Implementation Science Framework

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Purpose: This article describes the process of developing and implementing a supplemental early literacy curriculum designed for preschoolers demonstrating delays in literacy development.
Method: Intervention research and implementation research have traditionally been viewed as sequential processes. This article illustrates a process of intervention development that was paralleled by a focus on implementation in early childhood settings. The exploration, preparation, implementation, sustainment framework is used to describe factors that need to be considered during a progression through these 4 phases of implementation. A post hoc analysis provides insight into a rather nonlinear progression of intervention development and highlights considerations and activities that have facilitated implementation.
Conclusions: The guiding principles of the exploration, preparation, implementation, sustainment implementation science framework highlight the important considerations in developing effective and practical interventions. Considering implementation and sustainment during the intervention development process and using data-based decision making has the potential to expand the availability of user-friendly evidence-based practices in communication sciences and disorders and encourage a bridging of the researcher–clinician gap.

The distinction between intervention research and implementation research may be useful in elucidating how the former is driven by client outcome data and the latter is driven by adopters' use and perceptions of the intervention. Intervention research generates knowledge on the effects, efficacy, and effectiveness of an intervention that typically progresses iteratively, ideally with single-case experimental designs scaling up to randomized control and cluster randomized designs (Olswang, 1990). Implementation research focuses on how to facilitate the process of embracing and adopting evidence-based practices and sustaining high-fidelity use in everyday settings (Fixsen, Naoom, Blase, & Friedman, 2005).

The Center for Response to Intervention in Early Childhood (CRTIEC), a cooperative agreement funded by the U.S. Department of Education's Institute of Education Sciences, had a unique charge. The research team was charged with developing practical tools or resources necessary for implementing a viable response to intervention (RTI) system to promote school success among children who are at risk for reading disabilities. The tools and resources the CRTIEC team sought to develop included effective curricula, screening and progress monitoring measures, a decision-making framework, and associated training materials needed for implementing an RTI model. According to the cooperative agreement, the research team was expected to

- develop and evaluate Tier 2 and Tier 3 curricula for preschool language and early literacy skills,
- develop and validate an assessment system for universal screening and monitoring progress aligned with these curricula,
- carry out supplemental research responsive to the needs of early childhood educators and policy makers, and
- provide outreach and leadership to facilitate dissemination of efficacious tools.

The major focus of this article is on the development and implementation of the Tier 2 curriculum focusing on phonological awareness and alphabet knowledge. An overview of the overall project results is provided in Greenwood et al. (2014).

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Generating a feasible solution to address this charge within the context of early childhood education presented several challenges. Early childhood education encompasses a vast array of settings; we focused on public school pre-K, Head Start, and child care center classrooms. When working with this population, one must accommodate considerable diversity among children, who enter preschool with vast variations in their home language and literacy exposure. Teachers in early childhood settings vary considerably in their commitment (high rates of turnover) and professionalism, in their training (ranging from high school to master's degrees), and often in their philosophies of what they deem appropriate instruction for preschool children (Barnett, 2003; Early et al., 2007; Lee & Ginsburg, 2007). It is difficult to conceive of a preschool teacher being able to provide high-quality general classroom instruction (Tier 1) as well as small-group instruction for children falling behind (Tier 2) and individualized instruction for children with significant needs (Tier 3) without considerable assistance. Thus, a feasible solution required a measurement and decision-making system and curricula that were well developed, effective, and most important, easy to implement.

The genesis of our evidence-based approach to a Tier 2 early literacy curriculum was an intervention that embedded phonological awareness instruction on rhyming and alliteration in a small-group storybook reading session. Ziolkowski and Goldstein (2008) replicated the effects of this embedded intervention in multiple-baseline designs across behaviors with 13 low-income preschoolers with language delays. This early success led us to believe that we could translate this approach into an intervention that could be implemented with ease by paraprofessionals (e.g., instructional aides) in early childhood settings. As described below, much intervention research was required to achieve that goal. In addition, the focus on the acceptability and feasibility of implementation of the intervention informed the process from the outset. Although our explicit knowledge of implementation science was minimal at the outset of the project, it is instructive to present a post hoc analysis of the implementation process to identify what was facilitative, what may have been lacking, and what remains to be done as we continue to scale up our research on RTI in early childhood.

Implementation Science Framework

A number of frameworks have emerged within the field of implementation research. Many of these frameworks focus on the implementation and sustainment of currently developed evidence-based practices. For example, Damschroder et al. (2009) developed the consolidated framework for implementation research, which is a metaframework that is based on current research in implementation science. Although this framework addresses intervention characteristics, it does not address the development process of the intervention itself. However, the exploration, preparation, implementation, sustainment (EPIS) implementation science framework (Aarons, Hurlburt, & Horwitz, 2011) focuses on implementation as a process that may begin before an intervention has been fully developed. This framework best aligned with the development and implementation of our Tier 2 phonological awareness intervention.

Aarons et al. (2011) described the EPIS framework with four phases of implementation: exploration, preparation, implementation, and sustainment. In the following sections, we discuss the overall implementation process, describe strengths and weaknesses of the process, reflect on ways to improve the implementation and sustainability of the intervention, and discuss areas for future research on implementation of early literacy interventions.

The EPIS model was developed as a conceptual framework for implementing evidence-based practices in public service settings. The framework was specifically developed with child and family public service programs in mind (Aarons et al., 2011). Although our research team was not familiar with this work during the exploration phase of implementation, in retrospect, the process our team followed mirrored the major tenets of this model. Similar to other implementation models, there are inner and outer contexts to consider. This framework is unique in that variables within the inner and outer contexts influence each phase of the model. The EPIS model embraces iterative development, recognizing that the progression through these phases is not always linear, as earlier phases may be revisited during the development process.

Table 1 illustrates factors typically addressed at each phase of the implementation process in public sector services. The conceptual model considers outer context factors and inner context factors. These inner and outer factors are interconnected, and the characteristics of the innovative practices are evaluated for goodness of fit within organizations and systems. The outer context includes an evaluation of the broader interorganizational environment, the service environment, and consumer support. The inner context includes an evaluation of organizational characteristics and individual adopter characteristics. Table 1 shows how these factors differ depending on the phase of implementation. In applying this model to preschool settings, we classified inner contexts as anything at the level of the classroom inward. For example, individual classroom, teacher, and child and family characteristics are considered inner contexts. Outer contexts refer to factors broader than the individual building or classroom, such as federal and state policies, school district initiatives, administrative structures, and funding sources.

The Intervention and Implementation Context

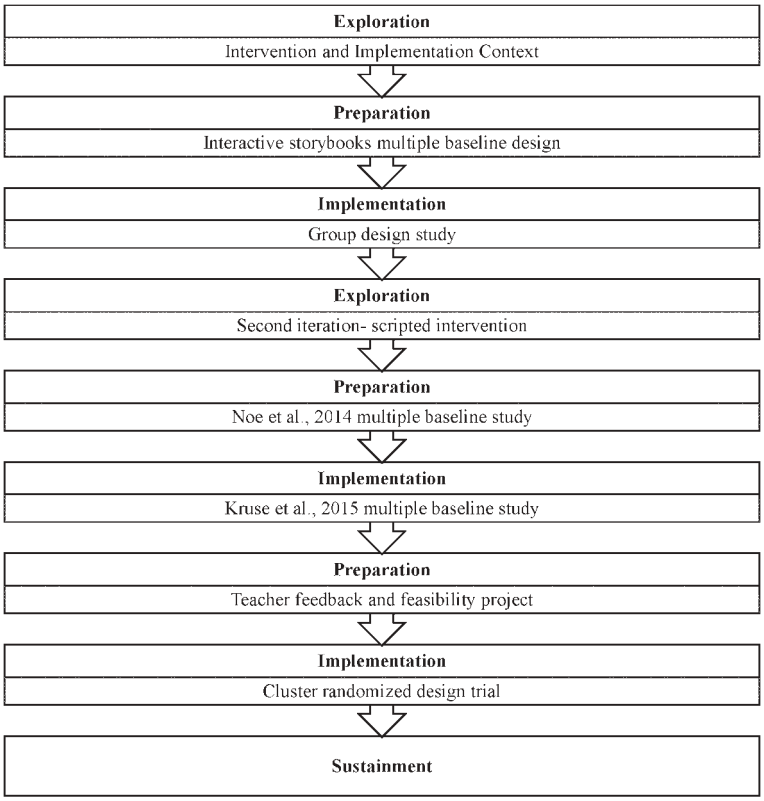
The development of the supplemental phonological awareness curriculum seems to align with phases of the EPIS implementation science framework, but the progression was not linear. Less than stellar effects during the initial implementation phase resulted in a return to exploration and preparation using a second iteration of the intervention. Figure 1 includes the stages of intervention development and the corresponding phases of the EPIS

Table 1. Exploration, preparation, implementation, sustainment model illustrating factors that influence stages of implementation.

Factor	Exploration	Preparation (adoption decision)	Implementation	Sustainment
Outer context				
Interorganizational environment	• Sociopolitical context and policies • Direct and indirect networks, technical assistance centers, professional organizations • Grant funding, continuity of funding	• Sociopolitical context and policies, legislation, definition of evidence • Organizational linkages, leadership ties • Formal and informal information sharing • Funding tied to state and federal policies	• Legislative priorities • Administrative costs • Organizational linkages, leadership ties • Information sharing cross-discipline translation • Funding for training and sustained fiscal support	• Sociopolitical leadership • Federal, state, and local policies and initiatives • Positive public–academic collaborations • Valuing multiple perspectives
Service environment	• Accountability policies • Monitoring and review	• Accountability policies • Monitoring and review	• Intervention developers engaged in implementation • Effective leadership practices • Cross-level congruence	• Funding fits with existing service funds or absorptive capacity • Workforce stability
Consumer support	• Advocacy organizations	• State or national advocacy • Lawsuits	• Community-based organizations	• State and local organizations
Inner context				
Organizational characteristics	• Absorptive capacity and skills • Readiness for change • Culture and climate • Leadership	• Size • Role specialization • Knowledge, skills, and expertise • Values	• Structure • Goals and priorities • Receptive and ready for change • Culture and climate • Evidence-based practices structural and ideological fit	• Leadership • Embedded evidence-based practice culture • Critical mass of evidence-based practice provision • Culture and climate • Social network support • Fidelity monitoring support • Role clarity and staff selection criteria and practices
Individual adopter characteristics	• Values and goals • Social networks • Perceived need for change	• Leadership • Culture embedding • Championing adoption	• Demographics • Adaptability • Attitudes toward evidence-based practice	• Demographics • Adaptability • Attitudes toward evidence-based practice
Interconnections among and within organizations	• Innovation characteristics • Fit within system and organization	• Innovation characteristics • Fit within system and organization	• Innovation characteristics • Fit within system and organization	• Innovation characteristics • Fit within system and organization

From "Advancing a Conceptual Model of Evidence-Based Practice Implementation in Public Service Sectors," by G. A. Aarons, M. Hurlburt, and S. M. Horwitz, 2011, *Administration & Policy in Mental Health, 38,* pp. 4–23. This is an open access article distributed under the terms of the Creative Commons Attribution Noncommercial License.

Figure 1. Phases of phonological awareness intervention development.



framework. Aarons et al. (2011) explained that the implementation process often includes revisions and a return to early phases. The following sections describe the process of trials and revisions for optimizing the phonological awareness intervention. We conclude by reflecting on the process to determine how future interventions can be developed with wide-scale implementation a consideration from the start.

During the exploration phase of implementation, outer context factors included obtaining grant funding and examining previous research and emerging policies on RTI related to early literacy skills. An implied policy mandate for RTI in early childhood, state and local education agency interest, and federal funding provided a supportive environment. Greenwood et al. (2012) highlighted many obstacles to overcome in implementing RTI in early childhood settings. These challenges include inconsistent and often limited teacher preparation and resources, an absence of or poor implementation of evidence-based curricula, a lack of intervention strategies tailored to at-risk children, and varying levels of administrative support. Thus, any interventions developed by the CRTIEC research team would need to be user friendly and low cost to accommodate these barriers to RTI in early childhood.

The inner context required the nurturing of interest and collaborative relationships with classrooms in the vicinities of our multisite research team in five states: Ohio, Kansas, Minnesota, Oregon, and Florida. The relationships varied on the basis of differences in service delivery models and goals among sites. For example, public pre-K in Ohio and child care centers in Florida were both motivated by the need to improve kindergarten readiness test results, but the classrooms differed in the training level of teachers and the time devoted to intentional instruction. Child and family characteristics were rather similar in that administrators directed our involvement to low-income neighborhoods in urban settings.

Previous research has identified children from minority groups and children with low socioeconomic status (SES) as being at greater risk for reading difficulties than nonminority, middle-class children (Snow, Burns, & Griffin, 1998). Children from low-SES homes are at greater risk for learning deficits for early literacy skills, including phonological awareness, alphabet knowledge, functions of print, and oral language (Bowey, 1995; Hart & Risley, 1995; Lonigan, Burgess, Anthony, & Barker, 1998; Smith & Dixon, 1995). However, low-SES children have demonstrated favorable responses to early literacy interventions (Ehri et al., 2001). This previous research on risk and resiliency served as part of the theoretical foundation for the mission of CRTIEC. In keeping with the need to have high-quality general instruction in an RTI model, we targeted receptive environments for implementation. Our minimal criteria for selecting partners for intervention development and eventual implementation were that classrooms were not currently implementing RTI

and had adopted curricula with a scope and sequence that included early literacy targets.

Early in the CRTIEC project, the research team conducted a large descriptive study to explore the quality of typical Tier 1 instruction in preschools (Greenwood et al., 2012). To better understand the need for RTI in early childhood settings, Greenwood et al. assessed more than 600 children's language and early literacy skills from 65 classrooms across four states at the start and finish of the preschool year. At the start of the year, students were assigned to Tier 1, 2, or 3 on the basis of their performance on early literacy screening tools. All students received "business as usual" instruction in the classroom. Students who were identified as Tier 2 or Tier 3 candidates at the start of the school year failed to close the performance gap by the end of the year. This finding supported the need for developing supplemental early literacy interventions for early childhood classrooms.

A theory of change informed our intervention research and guided the development and evaluation of a supplemental early literacy curriculum. The theory of change depicted in Figure 2 included inner contexts such as characteristics of the child, family, teacher, and classroom. According to the theory of change, students would range in risk and resiliency on the basis of these factors, as these predictors were potential moderators of the effects of intervention. On the basis of the results reported by Greenwood et al. (2012), at-risk students demonstrating delays in early literacy skills who receive "business as usual" classroom experiences were likely to receive limited explicit instruction on early literacy skills and thus continue to perform below their peers on corresponding measures. We hypothesized that effective supplemental instruction with explicit instruction, high rates of student engagement, repeated practice opportunities, and appropriate teacher feedback would provide a solid foundation to foster growth in early literacy skills and help at-risk students close the achievement gap. Thus, this theory of change served as the foundation for the intervention development process.

The Intervention Development Process

Preparation of First Iteration

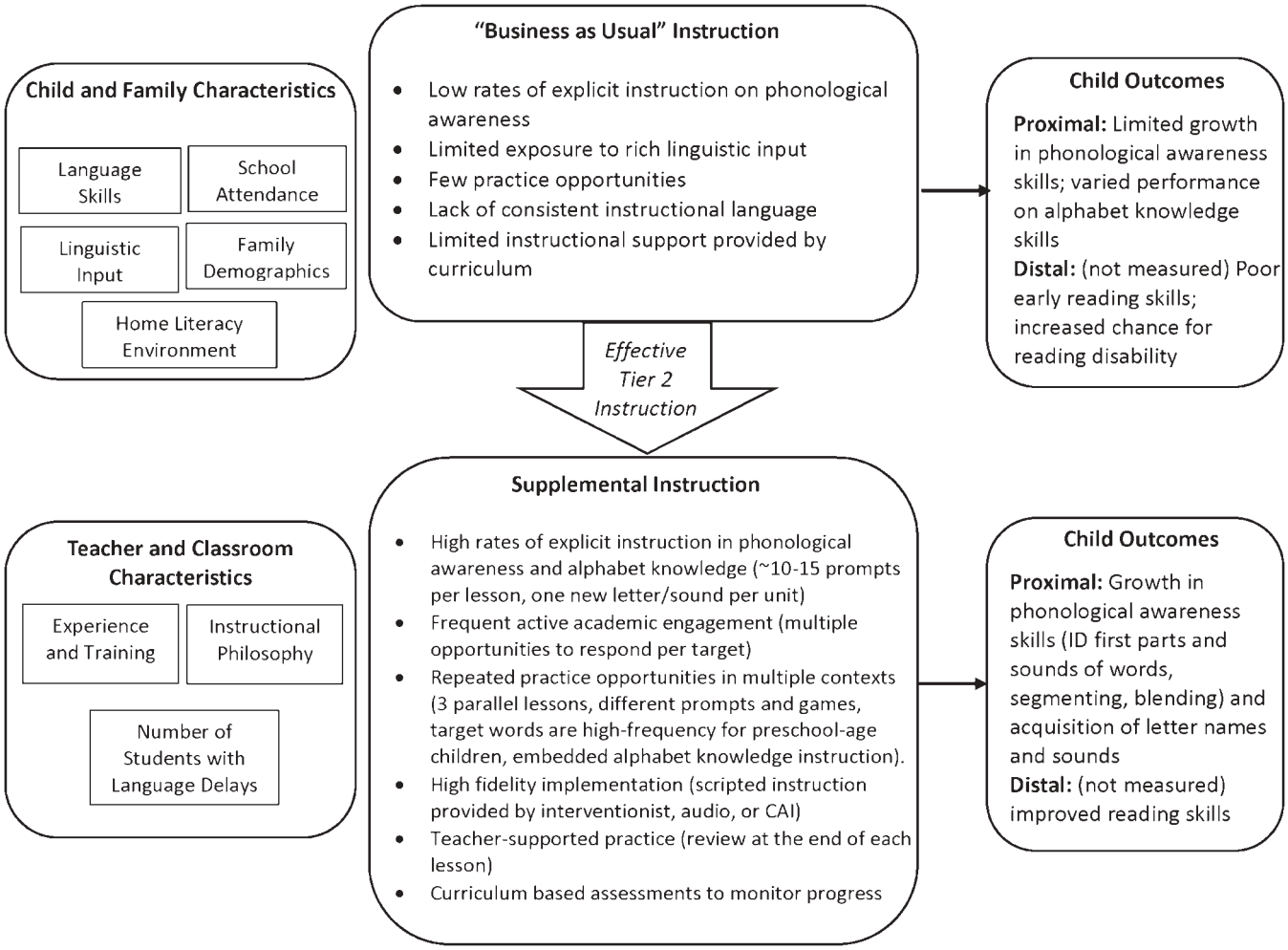
The preparation phase of the intervention included redesigning the intervention to encompass a more complete scope and sequence of phonological awareness skills. In addition, we sought to coordinate our Tier 2 intervention for children with delays in early literacy skills with the development of a Tier 3 intervention for children with more serious delays (Kaminski, Powell-Smith, Hommel, McMahon, & Aguayo, 2015). Moreover, participant testing using standardized measures, such as Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007), helped evaluate the adequacy of individual growth and development indicators (IGDI) for identifying children in need of tiered support (McConnell, Wackerle-Hollman, Bradfield, & Rodriguez, 2014). IGDI measures of rhyming, sound identification, first sound identification, and Dynamic Indicators of Basic Early Literacy Skills (DIBELS) Word Part Fluency and First Sound Fluency (Good & Kaminski, 2002) measures were general outcome measures that had the potential to sort children into appropriate tiers of support and monitor their progress with good accuracy.

The Ziolkowski and Goldstein (2008) study embedded intervention in existing children's books. However, the CRTIEC researchers determined that the time and cost of pursuing copyright permission for using published children's books was a major obstacle. The alternative task of creating our own books was time consuming but offered a number of advantages: We were able to control the length, vocabulary, and language; generate rhyming text; create book series with recurring characters; and encompass themes common to preschoolers' experiences. With the help of a professional narrator and professional illustrator, the team put together two series of prerecorded storybooks using Story Friends characters (Kelley & Goldstein, 2015). During the first 2 years of the CRTIEC project, much of the work included writing storybooks and organizing the supplemental curriculum.

During the curriculum development process, previous research on early literacy interventions for preschool children was explored. Few of the studies targeted children thought to benefit from a second tier of support because of low literacy skills (Koutsoftas, Harmon, & Gray, 2009). Most of the studies focused on classwide interventions that included phonological awareness training, typically considered Tier 1 support (Massetti, 2009; Schwanenflugel et al., 2010; Wilcox, Gray, Guimond, & Lafferty, 2011). Many other approaches provided individual instruction, typically considered Tier 3 support, with children with or at risk for speech and/or language impairments (Bowyer-Crane et al., 2008; Hindson et al., 2005; Nancollis, Lawrie, & Dodd, 2005; Roth, Troia, Worthington, & Handy, 2006). Common themes of interventions that have demonstrated efficacy include direct and explicit instruction (Justice, Chow, Capellini, Flanigan, & Colton, 2003), instruction at the phoneme level (Gillon, 2005; Hesketh, Dima, & Nelson, 2007; Lundberg, Frost, & Petersen, 1988; Nancollis et al., 2005; van Kleeck, Gillam, & McFadden, 1998), and instruction that combines phonological awareness and alphabet knowledge skills (Gillon, 2000, 2002; Justice et al., 2003). These principles were incorporated into the lessons that were developed for our curriculum. Implementation in a small-group format also was supported in previous intervention studies (Byrne & Fielding-Barnsley, 1995; Justice et al., 2003; Koutsoftas et al., 2009; O'Connor, Jenkins, Leicester, & Slocum, 1993).

As books were being developed, pilot testing with prototypes was conducted in several classrooms to gauge children's interest in the stories and the feasibility of the intervention. Teachers helped select students who would benefit from additional instruction. Researchers then implemented some lessons in the classroom with these students, and teachers observed and provided feedback. It became apparent during this pilot testing that students required multiple opportunities to respond and explicit instruction

Figure 2. Theory of change for Tier 2 early literacy intervention development.



on target skills. Lessons were modified on the basis of these observations.

Also during this time, curriculum-based assessments (IGDIs) were being developed, evaluated, and scaled using item response theory (McConnell et al., 2014). The use of IGDIs for identifying students struggling to learn phonological awareness skills was investigated. The assessments also served as a guide for the specific skills that should be targeted during intervention.

During the third year of the CRTIEC project, an experimental study was conducted. Instruction targeting rhyming, alliteration, and alphabet knowledge was embedded in the prerecorded storybooks. A multiple-baseline across-behaviors research design was implemented with nine preschool children. There was a loss of experimental control during baseline on measures of alphabet knowledge. Five of the nine students demonstrated effects on rhyme production, and six of the nine demonstrated improvements on DIBELS First Sound Fluency. Students did not demonstrate improvement on the IGDI curriculum-based measures. Because of the inconsistent results, it was difficult to determine whether the intervention itself, classroom instruction, or repeated testing were responsible for the gains on these skills.

Several changes were made on the basis of the children's performance. The lessons were refined to include more exemplars of instructional targets. The prerecorded stories were adjusted to include shorter response intervals, as children seemed to get distracted. It was determined that because phonological awareness is a metalinguistic skill, instruction should be broad rather than focusing on one or two discrete components (Anthony & Lonigan, 2004). Additional phonological awareness skills, including blending and segmenting, were added to the instruction. The alliteration task was changed to a first-sound identification task. Frequent, repeated testing was reconsidered because of two potential threats to our single-case experimental design. First, long baselines of incorrect responding sometimes resulted in stereotypic responding that children had difficulty overcoming once relevant skills were taught. Second, feedback on practice trials may have been sufficient for some children to learn phonological awareness skills.

Implementation of First Iteration

A group design study was conducted in the fourth year, with 39 students in groups of three randomly assigned to either the prerecorded phonological awareness intervention condition or a "business as usual" comparison condition. Members of the research team implemented the intervention in small groups outside the classroom. Group differences were significant for the DIBELS Word Part Fluency measure but not the First Sound Fluency measure, and the results for the IGDIs curriculum-based assessments did not differ significantly between groups.

It was clear that the effects were not as robust as the research team had hoped. Therefore, the intervention was re-evaluated and a plan was devised to make modifications. We noted that the prerecorded delivery of the instruction did not allow for differentiated feedback on children's responses. The lack of contingent feedback seemed to be an essential component of instruction, especially with children struggling to acquire this set of metalinguistic skills. The effects of this variable were examined in a subsequent study.

Exploration and Preparation of Second Iteration

A follow-up study was conducted with students who did not demonstrate gains during the prior study. The selection of children who had not demonstrated progress qualified this intervention as a Tier 3 adaptation to the intervention (Noe, Spencer, Kruse, & Goldstein, 2014). During this study, seven children participated in scripted small-group lessons with instruction similar to that which was embedded in the previous storybooks; however, students were given feedback on the basis of their responses and afforded additional practice opportunities. Researchers administered the lessons within the classrooms. During this multiple-baseline design study, five of the seven students demonstrated gains on the DIBELS First Sound Fluency measure following intervention. The results of the Noe et al. (2014) Tier 3 intervention with treatment resistors were strong enough to guide a major overhaul of our intervention approach. We concluded that for most children with delays in early literacy development, contingent feedback was an essential component and one that could not be incorporated within an automated, prerecorded instructional format.

Given the strong results and initial success demonstrated in the Ziolkowski and Goldstein (2008) study, we were disappointed in our progress. After 4 years and several informative studies that produced mediocre results, this overhaul was deemed a "do over." The data suggested that we rely on the literature, our collective wisdom, and clinical expertise to generate a new supplemental curriculum. For the sake of efficiency, we decided to abandon the storybooks as the context for instruction, and the research team worked to develop a set of scripted lessons that were easy to deliver and included explicit instruction on a variety of phonological awareness and alphabet knowledge skills. A scope and sequence was developed to include phonological awareness instruction starting at the whole-word level and progressing to the phoneme level across four distinct phonological awareness skills: blending, segmenting, first-syllable identification, and first-sound identification. Consistent with previous research (e.g., van Kleeck et al., 1998), rhyming was deemed an unnecessary skill for improving phonemic awareness and early literacy ability in preschool-age children; therefore, it was not included in the revision of the lessons.

The instruction included interactive trials, pictures, and movements or gestures to increase child engagement. Like its prerecorded predecessor, the scripted lessons were delivered in small groups during daily 10- to 15-min sessions. Different types of feedback were included on the basis of the groups' responses for each phonological awareness trial, thus allowing extra modeling and practice opportunities for items that were challenging to one or more students. The addition of feedback provides scaffolding for students who are learning new phonological awareness skills (Schuele & Boudreau, 2008).

Small-Scale Implementation of Second Iteration

The new supplemental curriculum, named *PAth to Literacy,* was evaluated in the fifth year of the CRTIEC project. An early efficacy study was conducted with groups of three students in three Head Start classrooms (Kruse, Spencer, Olszewski, & Goldstein, 2015). Members of the research staff administered the intervention outside the classroom. Students were identified as intervention candidates using a combination of IGDI and DIBELS screening measures. A multiple-baseline design across groups of participants was used to examine the effects of PAth to Literacy on phonological awareness skills of students. Seven students completed the intervention. DIBELS First Sound Fluency, Word Part Fluency, and Letter Naming Fluency served as the primary outcome measures for this study.

The results of the early efficacy study demonstrated that all students showed significant gains on the First Sound Fluency measure and maintained those gains. During baseline, experimental control was lost for two students on the Word Part Fluency measures, but only one child ever scored above 4 on First Sound Fluency. Following intervention, all students consistently scored above the benchmark for the beginning of the kindergarten year (10). Generalized effects were demonstrated across a number of phonological awareness measures, although average gains on the TOPEL phonological awareness and print knowledge subtests were not robust. This is likely due to the fact that many of the tasks in the TOPEL do not align with the skills taught in PAth to Literacy. The experimental results for this scripted intervention seemed strong enough to warrant a larger scale study with classroom staff administering the intervention, but factors related to implementation also needed to be considered.

Preparation of Large-Scale Implementation of Second Iteration

Two sources of information helped inform our preparation for implementation by teaching staff in classrooms. First, we took advantage of opportunities to solicit feedback from teachers who were interested in implementing our curriculum materials. Although researchers delivered the intervention in our prior studies, social validity assessments were gathered from classroom staff, who were interviewed and asked to complete brief, five-item Likert-type surveys to determine how satisfied they were with the PAth to Literacy curriculum. For example, in the Kruse et al. (2015) study, all three classroom teachers indicated that they felt that they would be able to incorporate the lessons into their classroom routines. The average score on the consumer satisfaction surveys was 5.4 (1 = *very unsatisfied,* 6 = *very satisfied*), indicating that teachers were satisfied with the intervention.

Second, after the Kruse et al. (2015) study, we actively sought assistance from teachers who had worked with us previously. Four teachers were recruited to practice implementing the lessons in their classroom to determine feasibility and training needs. These teachers were provided training materials including a manual, sample videos, and sample lessons. They also were provided two brief one-on-one training sessions with a member of the research staff to learn how to implement PAth to Literacy. These teachers were subsequently observed implementing the intervention on three separate occasions to determine the extent to which they could meet our criteria for implementation fidelity after minimal training. Although the training sessions were relatively brief (less than 1 hr), teachers administered the lessons with an average of 77% fidelity. This indicated that with extended training and regular coaching from the research staff, teachers would likely be able to implement the intervention in their classrooms with high fidelity.

Large-Scale Implementation of Second Iteration

Once efficacy and feasibility were established, the CRTIEC team organized an effectiveness trial of PAth to Literacy during the final year of funding. This multisite cluster-randomized design trial was conducted in 39 urban classrooms in Florida, Kansas, and Ohio. In Florida, 20 child care providers that delivered state-funded voluntary pre-K services participated in the study. In Kansas, 11 public preschool classrooms were recruited, and eight public preschool classrooms were recruited in Ohio. All teachers participated in an initial large-group training that lasted 2 to 3 hr. Teachers also received a comprehensive training manual and two training videos that they could use to prepare for delivering the intervention. Prior to the start of the intervention, a member of the research team visited the teacher in the classroom to complete a "checkout" procedure that included delivering part of a lesson to ensure that teachers understood the intervention and had a plan for integrating instruction into their daily routine.

Multiple waves of screening using DIBELS and IGDI screening methods and the TOPEL phonological awareness subtest were used to identify two or three students in each classroom who qualified for the intervention. It was important to conduct multiple waves of screening throughout the fall semester to help identify students with delays who were not demonstrating growth on phonological awareness tasks despite several months of Tier 1 (general classroom) instruction. Once researchers were certain that each classroom would have at least two or three candidates, classrooms were randomized to the PAth to Literacy intervention or to a comparison vocabulary intervention, Story Friends: Jungle Friends. Thus, all children received small-group instruction on the same consistent basis, providing a strong test of intervention effects rather than a business-as-usual control.

The intervention phase lasted 24 to 36 sessions depending on students' performance on lessons. Each lesson lasted approximately 10 to 15 min. Teachers or instructional assistants delivered lessons in the classroom. Members of the research staff provided weekly coaching support and completed measures of implementation fidelity. Overall, implementation fidelity was high, averaging 84% on an observational tool. Teachers responded favorably to weekly coaching, and most demonstrated improvement in fidelity scores as they progressed through the intervention.

A total of 113 students participated in this intervention. Results indicated that there were significant group differences on the DIBELS First Sound Fluency and Word Part Fluency measures and large effect sizes. Both groups demonstrated gains on the phonological awareness and print knowledge subtests of the TOPEL, although group differences did not reach significance. Among children who demonstrated delays in early literacy development monitored over the course of 4 months of instruction in their prekindergarten year, a large difference was shown in those meeting the benchmark for the beginning of kindergarten on the DIBELS First Sound Fluency test (81% vs. 34% in the experimental and comparison groups, respectively). Overall, these results indicated that teachers were able to effectively implement PAth to Literacy in the classroom, and students seemed to demonstrate relatively robust improvements on the targeted phonological awareness skills.

Following the intervention, teachers were asked to complete satisfaction surveys regarding their experience with the intervention in their classroom. The survey included 22 positive statements about the intervention and asked teachers whether they agreed with each statement on a Likert-type scale (1 = *strongly disagree,* 6 = *strongly agree*). Overall, teachers agreed with the statements (M = 4.20–5.07). Teachers were most satisfied with the adequacy of training and ease of lesson delivery. Teachers in Florida and Ohio rated the intervention more positively than did teachers in Kansas. The less-satisfied teachers noted that the amount of time required to deliver the lessons was burdensome and that it was difficult to engage students during some lessons. A focus group also was held to discuss changes the teachers recommended for the intervention.

Teachers in the focus group were satisfied with the results of the intervention but noted that it was sometimes difficult to manage the lesson materials. They had specific suggestions about units that required more effort to administer. They noted that it was initially difficult to focus on a small group of students at one time to provide appropriate feedback. The teachers in the focus group expressed interest in using the PAth to Literacy lessons in the future. Future iterations of PAth to Literacy will strive to integrate this teacher input.

Implementation Considerations

Exploration Phase

The intervention research described above corresponds mainly to the exploration and preparation phases of implementation. Aarons et al. (2011) suggest that there is little literature about the exploration phase because most of the literature focuses on the adoption of innovation. Perhaps because the federal funding agency required the CRTIEC team to play a leadership role, a good deal of attention went into this phase of implementation. For example, the CRTIEC team monitored changes in stages of implementation of RTI across the United States from 2009 to 2012 (Greenwood et al., 2014). Networks were formed through the CRTIEC website and an annual RTI in Early Childhood Summit. These networks discussed advocacy among professional organizations, which eventually resulted in a joint position statement (Pretti-Frontczak et al., 2014) that served to promote understanding and provide guidance for RTI frameworks in early childhood contexts. This proactive attention to outer context factors has helped set the stage and speed up the process for later phases of implementation.

Partnerships formed between the CRTIEC team and an array of early childhood education agencies helped to guide considerations of the inner context during the exploration phase. Multiple program structures were considered (e.g., Head Start, Title 1, public pre-K, subsidized child care, voluntary pre-K). Not all classrooms were ready to embrace change. For example, some programs that did not have a defined classroom schedule that included some type of center rotation incorporating explicit instruction were deemed poor candidates for implementing an RTI system. This did not disqualify many classrooms because a center rotation was a common practice. From its inception, Tier 2 early literacy intervention was designed to fit within that scheduled activity. Thus, the intervention was developed for daily small-group instruction during 10- to 15-min sessions. The intervention teaches skills that are widely recognized as being important for school readiness (phonological awareness and alphabet knowledge; National Early Literacy Panel, 2008). Programs that believed this goal was not developmentally appropriate were not good candidates for implementation. However, such beliefs were infrequent, as administrative leaders, at least, were aware that the targeted skills were included in kindergarten readiness testing in their states. In addition, there were state and national initiatives designed to increase reading skills in all children starting at an early age (e.g., Early Reading First). These interconnections between inner and outer contexts during the exploration phase facilitated movement into the preparation phase of implementation.

Preparation Phase

The preparation phase is when adoption decisions are made. Aarons et al. (2011) pointed out that adoption decisions are not a one-time event because organizations often choose to try out an innovation prior to broader implementation. Moreover, the CRTIEC staff did not have the resources to scale up implementation within large urban districts. However, we deliberately sought long-term partnerships whenever possible. This meant that we often worked in the same classrooms but with different cohorts of students; however, administrators moved us around to meet their needs as well. Administrators were agreeable to having research staff serve as the interventionists initially to ensure fidelity of implementation and demonstrate that the intervention was worthy of adoption. Because of the understanding that future scale-up efforts would involve teachers as interventionists, we sought their impressions of the intervention and what they would need to be able to carry out the intervention easily in their classrooms. Results were shared with administrators over the summer and with classroom staff (along with in-service training) each fall. In some cases, administrators were willing to evaluate results on kindergarten readiness tests, which went beyond the scope of our approved studies. This initiative on the part of the administrators was welcomed, however. They saw results that convinced them that students were benefiting from our involvement. That and the willingness of a research team to work with them year after year helped them become champions for adoption, which facilitated the next stage of implementation. The attention and resources that went into planning and development activities helped prepare sites for active implementation.

Active Implementation Phase

We have accomplished the early steps of active implementation in districts in Florida, Ohio, and Kansas. Teachers and aides from 39 classrooms were taught to implement early literacy or language interventions. This might be considered small-scale systems changes, as it represents a small percentage of the classrooms in these early childhood programs. This scale up was advisable as an initial step in evaluating the effectiveness of PAth to Literacy in authentic pre-K contexts. The results are being used to inform continued improvement of the intervention as well as the implementation process.

The outer context of statewide testing served as an important consideration in the implementation process. Because voluntary pre-K funding in Florida is contingent upon classwide performance on kindergarten readiness

testing (including phonological awareness skills), teachers were very motivated to adopt the PAth to Literacy curriculum. In several schools, teachers used the lesson materials with students in the class who had not participated in the intervention, and many teachers asked to keep the intervention materials following the conclusion of the study. The teachers in Kansas and Ohio were certified teachers with bachelor's degrees (or higher), whereas in Florida child care providers often lacked educational training and teaching certification. Differences in education or experience may have played a role in teachers' willingness to adopt new ideas and classroom interventions.

Inner contexts such as individual teacher and classroom differences were accounted for as well. Some teachers required frequent coaching support from the research staff. Other teachers delivered the lessons independently early on, and researcher interaction was limited to observing fidelity of implementation. Student behavior accounted for some of the variability in the amount of teacher support provided by the researchers. Several of the classrooms contained students who frequently engaged in challenging behavior, and the research staff problem solved behavior management and positive support strategies to implement in these classrooms. The number of staff in each classroom also contributed to the amount of support that teachers required.

Although inner and outer contexts were considered in the implementation phase of PAth to Literacy, several considerations of the EPIS model may have increased the effectiveness of the intervention. At the level of outer contexts, organizational networks should have been considered. In Florida, the voluntary pre-K classrooms received support from the district's school readiness office. Although the school readiness staff was supportive in recruiting classrooms, they were not sufficiently trained in the interventions or included during the implementation phase of the study to support sustainability efforts. For more effective implementation and sustainment, the district staff should be able to provide more support throughout the process, thus allowing the district to take more ownership over the intervention. Networks within the district also could be put into place to allow teachers to connect and share experiences during the implementation process. With more forethought, the research team may have been able to involve the district staff to a greater degree.

At the inner context level, individual teacher characteristics should have been considered further. In particular, teacher willingness to change or adopt new curricula should have been gauged more carefully prior to implementation. Alignment of interventions with school and teacher philosophy is important for sustained implementation within classrooms (Forman, Olin, Hoagwood, Crowe, & Saka, 2009). As mentioned before, teachers differed in their willingness to implement the interventions. Although all teachers provided informed consent and voluntarily agreed to participate in the study, it was clear that some felt it was an obligation whereas others utilized the study as a learning opportunity. In one particular instance, a teacher discontinued delivery of the lessons after the first 2 weeks of the study. She stated that she was overwhelmed with her responsibilities and did not have time to implement the lessons. She agreed to allow a volunteer provided by the research team to deliver the lessons in her classroom. Following the study, she expressed satisfaction with the lessons and the progress of her students and said that she would like to implement the lessons in the future. Although this teacher changed her attitude through the course of the study, it is clear that she was not willing to adopt a new intervention at the start. Developing relationships and perhaps probing further into each teacher's willingness to change prior to the initiation of the study may be needed to reduce barriers in implementation. It was interesting to see how attitudes can change over time. Many of the teachers in Ohio and Kansas had seen the interventions being implemented by the research team with their students. For many this raised their confidence in their ability to implement interventions they had observed, whereas others were resentful that they were being asked to add this instruction to their daily activities.

Sustainment Phase

Our team currently is focused on scaling up active implementation and moving into the sustainment phase of PAth to Literacy. Several teachers who participated in our study kept materials with the intention of continuing their use in classrooms. The school readiness program associated with the school district in Florida has expressed interest in utilizing the materials in all classrooms. For this to be feasible, a training and support team would need to be put into place. One obstacle to districtwide implementation is funding. Preschools, child care centers, and districts are limited in the funding they can use to purchase new materials. In retrospect, it would have been wise to involve higher administrative personnel in discussions and data sharing earlier, as the plans for allocating funds for curricula and for professional development often are made 1 year in advance.

Once funding has been secured, districts and organizations will need a system of training and coaching to support teachers implementing the intervention. This likely will be accomplished by training support staff at the district or organizational level or by teachers who volunteer to be training leaders. Members of the research team who helped develop the intervention should serve as leaders in the initial training phase, with a gradual shift of leadership to the organizational and classroom levels.

In addition to initial training, sustaining implementation will require ongoing coaching or other tactics (Forman et al., 2009). Some assistance may be provided through an online community of support that may include frequently asked questions, message boards, videos, and supplemental documents. This would allow teachers to access information and interact independently. Ongoing monitoring of implementation fidelity is important to ensure that students are receiving the supplemental curriculum as it was designed to be delivered (McKenna, Flower, & Ciullo, 2014).

Teachers also may require support integrating the intervention into their daily routines (Cornett & Knight, 2009). District training leaders and site coaches may be responsible for resolving scheduling conflicts. Further research should explore ways in which teachers can be fully supported in delivering interventions.

How to situate phonological awareness intervention within the larger context of a programwide RTI model also needs to be investigated. The PAth to Literacy team has partnered with a group of researchers who specialize in behavior and social–emotional support strategies using an RTI (pyramid model) system for preschool-age students (Fox, Carta, Strain, Dunlap, & Hemmeter, 2010). An effort is currently under way to examine ways in which an integrated RTI model can be effectively developed and implemented within preschool classrooms. Although interventions addressing behavior, language, and literacy have been effective in stand-alone studies, it is important to explore how to integrate these interventions in classroom contexts (Ball & Trammell, 2011).

One issue that arises with integrating the supplemental curriculum into an RTI model is the reliance on regular screening and progress monitoring assessments. In the implementation studies described, all testing was conducted by members of the research staff. Teachers are likely to require training to learn how to administer the measures and make decisions regarding assigning students to differentiated tiers of instruction. In addition, when the phonological awareness intervention was modified, the curriculum-based measures (IGDIs) were not modified accordingly. This may have resulted in a misalignment of testing and instruction, which could explain the lack of robust results on the IGDIs during the cluster randomized trial of PAth to Literacy. Future work will further develop curriculum-based measures to monitor student growth on discrete skills taught in the supplemental curriculum.

Conclusions

Even though implementation of PAth to Literacy was not specifically guided by the EPIS model, it is clear that many of the principles aligned. There were several strengths in our implementation process. Perhaps the most important component of this journey was the constant use of data-based decision making. From pilot testing to single-subject experimental design studies to larger group design studies, each step of the intervention development process relied on collecting data and making adjustments to the intervention as necessary. This may make a difference between a mediocre and a potent evidence-based practice. It is important that continued active implementation and sustainment phases of implementation capture information that also can be used to help improve and refine the intervention.

Feasibility of implementation was considered consistently from the exploration phase on. The researchers understood many of the challenges to delivery of RTI services in early childhood settings and anticipated some of the implementation difficulties. Factors such as low cost, ease of delivery, and short duration of intervention were important considerations from the start. Teacher feedback was utilized during all implementation trials so that appropriate adjustments could be made to improve feasibility. However, social validity assessments that occur only at the end of studies may not be the best means of getting honest feedback (Goldstein, in press; Schwartz & Baer, 1991). The research team had the benefit of informal conversations because of frequent visits to classrooms. We discussed these conversations with teaching staff in our weekly lab meetings because they often were important sources of information about teachers' perceptions of the intervention.

We found ourselves abandoning an intervention format (prerecorded lessons embedded in storybooks) that had enjoyed initial success, delivered in a manner that was highly acceptable to teaching staff, because of less-than-stellar results. This illustrates the nonlinearity that can occur in intervention development and implementation processes. It unfortunately took three expensive studies (only one of which was published) before we made the decision to overhaul the intervention. Nevertheless, this tradition of following the data and creative problem solving is what science is all about. Although PAth to Literacy has demonstrated efficacy and effectiveness, the research team is continuing to explore, plan, and implement modifications to the lessons. This refinement process allows researchers to strive for more effective and efficient means of delivering services. The process also helped the research team understand that different media were effective for teaching different skills. For example, prerecorded storybooks were effective for teaching vocabulary (Kelley & Goldstein, 2015; Spencer et al., 2012) but not for teaching phonological awareness skills.

The federal funding of a multisite collaborative agreement afforded the developers the unique experience of gaining insight from researchers with varied areas of expertise as well as from teachers and students from different geographic settings. Effects of the intervention were replicated across three separate locations under the supervision of separate but coordinated research teams. In addition, CRTIEC team members contributed their own unique experiences and expertise to the project. The simultaneous development of assessment and multiple interventions was beneficial in understanding how each specific intervention fit within the larger context of early childhood.

Last, the gradual release of control from the intervention developers to the classroom teachers was important for implementation. This afforded researchers firsthand experience that continues to guide future development of the intervention with feedback from teachers. It also allowed researchers to closely observe implementation of PAth to Literacy within classrooms by trained teachers and their instructional assistants. Specific training and support needs were identified. For example, we realized that paraprofessionals who initially may have been hesitant often excelled in delivering the scripted lessons in small groups. The close partnership of the intervention developers and the classroom teachers allowed for a collaborative development process.

Although the implementation of PAth to Literacy has experienced initial success, attention to additional outer and inner context factors is needed to continue scaling up this Tier 2 intervention, to explore the breadth of applicability (e.g., kindergarten), and to promote sustainability across different early childhood settings.

Approximately 10 years of intervention development and evaluation provided an ever-changing research team intimate knowledge of many facets of early literacy. It is through many years of research that one gets to know a behavioral phenomenon. These experiences reinforced the need to not be easily satisfied, as we continue to seek better measurement schemes and more potent intervention procedures. We are aware that abandoning an automated intervention format in favor of a scripted intervention presents new challenges. We have learned that implementation is feasible and results appear to be robust, but it will require more effort to maintain sustainability with high fidelity. The process of creating a supplemental curriculum that was effective and practical may seem analogous to the adage about "building the plane while flying it." We contend that researchers will do the field a disservice if they do not balance the processes of intervention and implementation development. Like much of the behavioral sciences, communication sciences and disorders have too few evidence-based practices that have undergone years of iterative development and refinement to the point of producing optimal, well-defined intervention protocols. By considering implementation and sustainment during the intervention development process and using data-based decision making, the field will hopefully expand its repertoire of user-friendly evidence-based practices and encourage a bridging of the researcher–clinician gap.

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