

The translation of an evidence-based preschool physical activity intervention from in-person to online delivery of professional development to preschool teachers

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Abstract

Study of Health and Activity in Preschool Environments (SHAPES) aimed to increase preschoolers' physical activity by engaging preschool teachers in professional development designed to modify instructional practices. SHAPES originated as a randomized controlled trial, tested in 16 preschools and disseminated to 4 control schools, and was shown to be effective in increasing preschool children's physical activity (Phase I, 2008–2012). This article describes the steps taken to translate an evidence-based physical activity intervention, SHAPES, from in-person delivery to online delivery of professional development to preschool teachers. In Phase II (2013–2016), professional development delivery was modified from an in-person to an online program for preschool teachers. Teacher implementation completeness and fidelity were examined in 10 pilot preschools and then replicated in 30 preschools. Large-scale dissemination of SHAPES began in Phase III (2017–2019), reaching 818 teachers from 228 unique centers after 2 years. The final SHAPES program consisted of six online modules, an accompanying guidebook, over 90 activities, self-assessment techniques, a video library, and an electronic community forum. The SHAPES core elements, defined in Phase I, were retained throughout all three phases. The Phase II change to online delivery was characterized by high levels of implementation completeness and fidelity. Results of Phase III statewide dissemination revealed comparable implementation completeness and fidelity. An intervention shown to be effective in a randomized controlled trial can be translated into an online professional development program and disseminated on a large scale in a timely manner.

Keywords

Preschools, Physical activity, Online professional development, Translation, Dissemination

BACKGROUND

The number of young children who attend center-based early childhood education and childcare programs (e.g., preschools, childcare, Head Start) has increased dramatically in recent decades [1]. In 2016, about 42% of 3 year olds, 66% of 4 year olds, and 86% of 5 year olds were enrolled in preprimary programs [2]. Such settings are in a unique position

Implications

Practice: Ongoing involvement of site-based staff (e.g., preschool teachers) in intervention design and delivery is essential to effecting organizational change (e.g., change in classroom instructional practices) to support behavior change in populations served (e.g., increased physical activity in preschool children).

Policy: Providing regular physical activity opportunities for young children can increase physical activity, which is important to child development.

Research: Successful and timely translation and dissemination of evidence-based interventions is facilitated by developing flexible interventions with clear core elements beginning with the initial randomized control trial.

to influence young children's health and development by providing play and physical activity opportunities [3]. Accordingly, the Institute of Medicine (IOM), now the National Academy of Medicine, recommends that early childhood settings (hereafter referred to as preschools) provide daily indoor and outdoor physical activity opportunities for at least 15 min/hr [4], and the Society of Behavioral Medicine recommends increasing physical activity during child care hours to 120 min per day [3]. Similarly, the 2018 Physical Activity Guidelines for Americans include two key recommendations for physical activity and active play throughout the day for young children [5]: (i) preschool-aged children (ages 3 through 5 years) should be physically active throughout the day to enhance growth and development and (ii) adult caregivers of preschool-aged children should encourage active play that includes a variety of activity types. Evidence indicates, however, that young children spend a considerable

amount of time in sedentary behavior during the preschool day [6].

The preschool children attend greatly influences their physical activity levels, which may reflect differences in the policies, practices, and environments within that setting [7–10]. A teacher's classroom practices may exert a particularly important influence on physical activity in preschools and, with the present emphasis on preacademic activities, those practices may not be conducive to physical activity. For example, written physical activity policies (e.g., regular breaks for recess) are not always enforced in preschool settings [11–13]. Although many preschool teachers do not receive regular physical activity training [13], studies suggest that providing professional development may enhance children's physical activity [14, 15].

Professional development, which consists of facilitated teaching and learning experiences, may promote the application of knowledge and skills into practice [16] and is a major component of education [16, 17]. Facilitated approaches to learning have the potential to stimulate higher-order organizational learning [18]. For example, teachers may create school-level change by ending habitual use of long-held instructional practices, questioning the meaning and value of existing practices, and adopting new practices [19]. Therefore, effective professional development has the potential to create sustainable organizational change to promote physical activity in large numbers of young children.

Online professional development has become widely accepted and is an effective strategy to implement change within the classroom [20, 21]. However, few studies have explored it as a method to increase physical activity [21–23]. One recent study found that an online professional development program significantly increased students' physical activity during physical education and improved teachers' class management and instruction strategies [21].

A study also found that childcare centers were receptive to online physical activity and nutrition professional development programs, provided they are easy to use [24].

Preschool-based physical activity interventions have generally increased physical activity in young children [14, 15, 25–27], yet there is a need for larger-scale dissemination [26, 28]. Well-designed online professional development programs can increase the potential for widespread dissemination and enhanced population reach in “real-world” settings and may allow for flexible, cost-effective implementation of physical activity interventions [20, 22]. Furthermore, transparent reporting on the process involved in translating effective preschool physical activity interventions into widespread practice can aid in future public health dissemination efforts. Therefore, the purpose of this article is to describe the steps taken to translate an evidence-based physical activity intervention, Study of Health and Activity in Preschool Environments (SHAPES), into an online professional development program for preschool teachers. Figure 1 depicts the development and testing, translation, and dissemination processes of SHAPES in three phases over about 12 years: Phase I: group randomized trial; Phase II: translation; and Phase III: statewide dissemination.

PHASE I: GROUP RANDOMIZED TRIAL

Primary trial

Methods

The Study of Health and Activity in Preschool Environments (SHAPES) was a group randomized trial consisting of a flexible, multicomponent, ecologic intervention with eight intervention and eight control schools. Details of SHAPES are reported elsewhere [29–31] and are summarized briefly here. Preschools were pair-matched and

Planning & Implementation Processes	Phase I. Group Randomized Trial					Phase II. Translation				Phase III. Statewide Dissemination		
	2008–2011: Core investigation in 16 preschools (8 intervention and 8 control)					2013–2014: Development of online implementation approach				2017: Large-scale dissemination began		
	2011–2012: Modified implementation to 4 of 8 control schools					2015: Online implementation pilot in 9 preschools				Target of 400 preschools in a series of waves, or cohorts, over three years		
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1. Planning												
Intervention Development												
Research/ Evaluation Design & Measurement Development												
Implementation Planning												
2. Intervention Implementation												
3. Modification based on Feedback and Evaluation												

Fig 1 | Development and testing, translation, and dissemination processes of SHAPES in three phases.

randomly assigned to condition; the children in the two groups were comparable on age, sex, gender, and physical activity at baseline. Only intervention schools received the SHAPES program; both groups received the full measurement protocol. SHAPES aimed to increase physical activity in preschool children by modifying teachers' instructional practices, using a facilitated learning approach to professional development for preschool teachers. The intervention targeted teaching practices in three key settings: indoors ("Move Inside"), outdoors ("Move Outside"), and preacademic lessons ("Move to Learn"), and equipped teachers with the necessary knowledge and skills to modify the social and physical environments to facilitate child physical activity. Full implementation was characterized by teachers providing 300 min of physical activity opportunities weekly through a combination of opportunities in Move Inside, Move Outside, and Move to Learn. Full implementation fidelity included a social environment characterized by teacher involvement in and child enjoyment of physical activity opportunities, and children being physically active during physical activity opportunities. The resulting flexible, ecologic physical activity intervention was well received and effective in increasing objectively assessed moderate-to-vigorous physical activity in preschool children [31].

The formal intervention was implemented by the eight participating intervention preschools (20 classrooms), with research intervention staff assistance, over two consecutive years, plus a third year as the initial translation step with greatly reduced intervention staff involvement. In Year 1, intervention staff provided individualized on-site training for each preschool, one multischool group workshop, and three site visits per month; in Year 2, staff provided four multischool group workshops and two site visits per month; and in Year 3, staff provided two multischool group workshops and optional site visits. During site visits, intervention staff provided consultations and demonstrations [29]. The workshops served as an opportunity for SHAPES teachers to come together as a community and discuss successful implementation strategies and barriers to implementation.

Complete methodology for comprehensive implementation monitoring has been reported previously [32]. Briefly, Phase I implementation monitoring was guided by a comprehensive conceptual model of the physical activity-promoting environment in preschool settings. It included multiple methods of data collection from multiple data sources (observation, teacher report, and staff rating) for three components of implementation completeness (provision of physical activity opportunities through Move Inside, Move Outside, and Move to Learn) and two components of fidelity (provision of a socially supportive and enjoyable physical activity environment

characterized by physically active children during activity time).

Results

Most teachers felt adequately prepared to carry out SHAPES (73%) and believed that SHAPES was worthwhile (82%). As described by Saunders and colleagues [32], teacher report for completeness of delivery (providing physical activity opportunities through Move Inside, Move Outside, and Move to Learn) was 60%, 56%, and 76% in Years 1, 2, and 3, respectively; results obtained via direct observation were similar (65%, 53%, and 76%, respectively). Fidelity, assessed by combined classroom observation and teacher-reported child enjoyment during activity opportunities, was high (88%) (combined for Years 2 and 3; not assessed in Year 1); teacher encouragement/participation with children, assessed by a combination of teacher and staff report as well as classroom observation, was somewhat lower in Years 2 and 3 (55% combined for Years 2 and 3) [32].

Modifications in Phase I

Modifications were based on teacher feedback obtained through quantitative and qualitative surveys throughout the study. As described by Howie and colleagues [30], the biggest changes were made between Years 1 and 2, when the number of intervention components was reduced (physical activity centers, TV turnover, and school policy and practice were dropped because they were not tenable during the preschool day), and the time goal for the total amount of physical activity opportunities was reduced from 500 to 300 min per week (preschool teacher feedback indicated that the 500-min goal was not feasible). Similarly, the language used to describe the intervention components was simplified and clarified to its current form (e.g., "Move Inside" vs. "Skill SHAPeRS") based on teacher feedback [30]. After the essential elements were established following Year 1, the SHAPES intervention delivery evolved over 3 years, with systematic reductions in direct support from the interventionists to build capacity of the preschool teachers to independently implement SHAPES [30]. Thus, by Year 3 of Phase 1, SHAPES had achieved acceptable levels of implementation, was more feasible to implement, and was effective in improving MVPA in preschool children. The research team planned a systematic dissemination of SHAPES to the control schools to further improve delivery of SHAPES.

Dissemination to control preschools

Methods

After reviewing process data, teacher feedback, and interventionists' experiences, planning for dissemination to controls aimed to further reduce the number of workshops and site visits while adhering

to the essential elements [33]. Additional materials, including the SHAPES Philosophy, a SHAPES Guidebook, and illustrative activities, were developed to support the shift toward a more sustainable intervention delivery approach. As described by Howie and colleagues [33], implementation monitoring during dissemination to control schools was similar to that provided in the primary trial.

SHAPES was delivered to the four of eight control preschools (12 classrooms) that agreed to participate [33]. The intervention content was divided into five modules that were delivered in two multischool group workshops, a classroom site visit, and 6 months of additional assistance [33].

Results

SHAPES was favorably received by participating preschool teachers. As previously reported [33], most preschool teachers (73%) felt “very prepared” to carry out SHAPES; the remaining (27%) felt “somewhat prepared.” Teachers found participation in SHAPES to be “worthwhile” and all reported being “very likely” to continue SHAPES. There were no significant differences in minutes of physical activity opportunities and percentage of classrooms achieving SHAPES intervention goals between the control dissemination group and the primary trial group (total minutes of opportunity = 73% vs. 77%, respectively), despite a considerable reduction in in-person site visits and support from interventionists [33]. All teachers (100%) reported that children “liked” or “loved” participating in SHAPES activities and most teachers (86%) reported “encouraging and frequently joining” physical activity in Move Inside and Move to Learn. Table 1 includes a summary of the evaluation design, implementation monitoring methods and results, and feedback and adjustments for Phase I.

Given the effectiveness of SHAPES implementation with greatly reduced research staff support, the focus shifted to developing a platform through which SHAPES could be translated (Phase II) and disseminated (Phase III) on a larger scale for greater public health impact. After considering several options, the SHAPES team pursued an online approach to working with preschool teachers to facilitate physical activity-promoting environments in preschool settings because of the potential for broad geographic reach.

PHASE II: TRANSLATION

The goal of the Translation phase was to design and test an online training program to deliver the evidence-based SHAPES program (now known as “Supporting Health and Activity in Preschool Environments”), while retaining the essential elements of the program established in Phase I. The SHAPES Translation Phase included three stages: web development (2013–2014), a pilot study with

nine preschools (2015), and a translation study involving 23 preschools (2016).

Web development

The SHAPES team created a website within the university’s web framework that included a series of six online modules that delivered the program content and an interactive online community for participating preschool teachers and staff. The design of the online program incorporated feedback from teachers through quantitative surveys, qualitative interviews, and recommendations from Phase I teachers for the translation of SHAPES to a web-based format. This feedback guided the changes described below.

The development of online modules and accompanying materials included the following tasks that were accomplished iteratively: (i) planning the modules, including translating SHAPES content into six modules, developing the script to accompany the online media images, and creating interactive elements such as quizzes and activities; (ii) developing the supporting online materials, including the SHAPES Guidebook that mirrored the module content; (iii) working with the university’s media team to shoot pictures and film videos; (iv) working with the university’s web development team to create consistent and predictable layouts as well as pleasing visual design (e.g., aesthetics, typography, images, colors); and (v) addressing technical and logistical issues, such as requirements for logging into the website and platforms that would likely be used for viewing modules (e.g., laptops, phones, tablets). Furthermore, the research team established collaborative relationships with local professional development continuing education providers and conferences, so that participating preschool teachers could obtain Continuing Education Units.

Moving to a primarily visual format required that the SHAPES team consider literacy levels, culturally appropriate messages and images, and message clarity [34]. Nationally, most preschool teachers are women (99%), 22% are racially/ethnically diverse, and about 65% hold an associate’s or bachelor’s degree [35]. To appeal to a very wide audience of teachers, the avatar who leads teachers through the modules is female but ethnically ambiguous, and a research team member with no apparent regional American accent was chosen to narrate the modules.

In addition to web-based module content, the research team created a variety of supporting materials that preschool teachers and directors could download from the website. These included a printed guidebook with approximately 75 sample activities to facilitate program implementation, activity cards with illustrations depicting various movements (e.g., gallop, jump, jog), a poster displaying SHAPES goals, a SHAPES activity chart to enable participants to plan and track opportunities for physical

Table 1 | Comparison of SHAPES delivery approach, evaluation, implementation monitoring results, and feedback/adjustments for the three phases

SHAPES phase	Delivery approach	Evaluation design	Implementation monitoring	Completeness	Fidelity	Feedback and adjustments
Phase I: group randomized trial	Primary trial	Pre- and post-testing of behavioral outcomes; implementation monitoring via observation and surveys to teachers and staff	Completeness	Meeting weekly goal for providing PA: Year 1 = 60%; Year 2 = 56%; Year 3 = 76%	Teacher active with children: 53% Child enjoyment: 88%	Reduced number of components and time goals
	Dissemination to control schools	Implementation monitoring via observation and surveys to teachers and staff	Fidelity: social environment	<ul style="list-style-type: none"> Percentage of 300-min weekly goal for providing PA opportunities 	Teacher active with children: 86% Child enjoyment: 100%	Reduced in-person contact to increase change agent autonomy
Phase II: translation	Translation pilot	Implementation monitoring via observation and surveys to teachers and staff	Fidelity: PA	Meeting weekly goal for providing PA: 95%	Teacher active with children: 100% Child enjoyment: 91%	Shifted delivery mode from in-person to online
	Translation trial	Implementation monitoring via observation and surveys to teachers and staff	<ul style="list-style-type: none"> Teacher participation in PA activities Child enjoyment of PA 	Meeting weekly goal for providing PA: 80%	Teacher active with children: 84% Child enjoyment: 97%	Iterative development of online program and support materials
Phase III: dissemination	Statewide dissemination	Implementation monitoring via teacher report only	Monitoring processes listed above, plus electronic monitoring of module completion and online participation	Meeting weekly goal for providing PA: 85%	Teacher active with children: 81% Child enjoyment: 90%	

activity, and a SHAPES self-assessment worksheet designed to help participants maximize the quality of SHAPES implementation in their classrooms.

Pilot study

Methods

To eliminate the potential barrier of limited access to online technology, participating schools received a web-enabled laptop computer to share among preschool teachers who enrolled in the SHAPES program. The six online modules included an introduction to physical activity definitions and concepts, Move Inside, Move Outside, Move to Learn, self-assessment, and a program review. In addition to the online materials, participating teachers received hardcopies of the accompanying guidebook, sample activities, and laminated activity cards to help facilitate implementation. Teachers were asked to complete one module per week in sequential order at a time that was convenient for them. At the end of each module, teachers posted on the community discussion board and completed a brief quiz to assess understanding of the module content.

Teachers provided feedback on the SHAPES experience via quantitative surveys from all teachers and qualitative interviews with a subset at the end of the pilot study. This information was used to improve the program, as described below.

Implementation monitoring in Phase II was comprehensive, including process observations and teacher follow-up surveys, and results for the translation pilot study were reported in Kennedy and colleagues [23]. Nine of the 10 preschools contacted agreed to participate in the translation pilot study to evaluate the dose received (i.e., teacher module completion, assessed via real-time online monitoring), classroom implementation completeness (i.e., provision of 300 min of physical activity opportunities), and fidelity (i.e., achieving physical activity fidelity and social environment fidelity). This included 41 lead and assistant teachers in 26 classrooms who delivered the intervention to 515 children [23].

Based on random assignment, five schools had no in-person contact with the SHAPES team (distance-only group), whereas four schools received in-person visits from the SHAPES team (in-person group) after Modules 2, 3, and 4. In-person visits were not interactive and consisted of activity observations followed by written feedback emailed to each teacher.

Results

Online training resulted in effective classroom implementation [23]. Online module completion was good in the distance-only group (77% completing all six modules; 86% completed at least five modules) and adequate in the in-person group (65% completing all six modules; 79% completed at least five modules). Both groups had very high levels of teacher-reported physical activity opportunities

(100% for distance-only and 87% for in-person), teacher-reported being active with children (100% each), and process-observed child enjoyment (94% for distance only and 87% for in-person). As reported by Kennedy and colleagues, results exceeded those reported in the initial SHAPES trial. Similarly, teacher response to the intervention was very positive. Teachers felt prepared to carry out SHAPES (mean 2.8, *SD* 1.4 with 4 = very prepared and 0 = very unprepared) [23], suggesting that online dissemination is a viable strategy for SHAPES.

Modifications from pilot study

Teachers at in-person schools expected to receive more support than was provided, and the required discussion board posts were not well received by all teachers. Teachers indicated that they would benefit from more video examples. The SHAPES team also determined that the program would benefit from improved photography, higher quality activity cards, more sample activities, pictures illustrating movements with descriptions and modifications, a stand-alone website, and a higher quality guidebook. Several cosmetic changes to the modules were also needed, including an increase in font size to enhance readability and a new interface that allowed the modules to fit the full screen and adapt to various devices and browsers.

Translation study

Methods

The research team made extensive improvements to the program in this phase of the translation process. These changes included creating a stand-alone site, www.goshapes.org, to house the program; updating the modules to include richer video content; making the discussion board an optional resource; filming a variety of activities at local schools and using those to create a video library on the website; and creating SHAPES Pinterest boards for activities, music, and classroom tips so that each participant could utilize and contribute to those resources.

In addition to online improvements, the team updated all printed materials to make them more user-friendly and effective. This included editing the guidebook to include professional photographs to illustrate SHAPES concepts and simplify the content, creating additional sample activities (for a total of 90 activities), and moving them to a separate activity binder. The activity binder also included “The SHAPES Playbook,” a series of pictures illustrating movements with descriptions and modifications for children of various ages and motor skills, and an “Active Alphabet” reference sheet, an alphabetical bank of action verbs. We simplified the poster with SHAPES goals, the SHAPES activity chart, and the SHAPES self-assessment form to make them clearer and more visually appealing. We created three new laminated, ring-bound sets of activity cards using

professional photographs of preschool-aged children performing each movement. Each updated activity card included a description of the movement and tips to maximize intensity.

Additional website changes included (i) providing a week between modules to allow teachers to practice implementing activities and to increase the deadline for module completion to 2 weeks, (ii) moving the embedded quizzes from within the modules to the end of the modules so that they stand alone and can be more easily updated to reflect new content without relying on the web design team, and (iii) making the self-assessment an interactive activity within the module.

Twenty-three preschools and 125 teachers and assistant teachers, plus 18 directors and 6 other preschool staff, participated in the translation study; this included five preschools in which teachers received in-person contact. Teachers at distance-only schools completed all six SHAPES modules online with no in-person contact with the SHAPES team. Distance-only teachers were given the opportunity to receive feedback based on video uploads. Teachers at in-person schools completed all six SHAPES modules online and received additional support from the SHAPES interventionist, who visited each in-person classroom after completion of Modules 2, 3, and 4. In-person visits consisted of activity observations, immediate feedback, and opportunities for teachers to ask questions and discuss SHAPES with the interventionist. Every in-person visit was followed by extensive written feedback emailed to each teacher.

We obtained teacher feedback through quantitative surveys and qualitative interviews at the end of the translation study. This information was used to enhance the program, as described below.

Results

Both the distance-only and in-person groups reported acceptably high levels of perceived preparation to carry out SHAPES (mean/*SD* = 3.4/0.42 and 3.8/0.66, respectively). Overall implementation of the SHAPES program was good, at the 75% level or higher. Module completion was 77% and 91% for the distance-only and in-person groups, respectively. Teacher-reported completeness for providing physical activity opportunities was 75% and 68% for distance-only and in-person groups, respectively; for process observation, it was 85.7% and 100%, respectively. Similarly, 77% and 71% of distance-only and in-person teachers reported meeting the weekly goal. Both groups were high in teacher-reported social environment fidelity for teacher participation and child enjoyment (both above 80%), and very high for process-observed child enjoyment (100% for both groups). [Table 1](#) includes a summary of the evaluation design, implementation monitoring methods and results, and feedback and adjustments for Phase II.

Modifications from translation study

In-depth interviews with participants following program completion indicated that the teachers particularly appreciated the videos, activity cards, sample activities, and guidebook. Teachers indicated that the online program was easy to use, even for participants with limited online experience. Observational data and participant feedback indicated that the program would benefit from a streamlined website with program material in chronological order and sequential completion enforced by embedded web mechanisms.

This experience indicated that online training was effective, with relatively low burden to preschool teachers and the potential for great reach. The SHAPES team then prepared SHAPES for broader geographic dissemination to larger numbers of teachers statewide in Phase III.

PHASE III: STATEWIDE DISSEMINATION

Methods

Statewide dissemination of SHAPES, a 3-year process, began in 2017 and is ongoing through 2019. Planning in Phase III shifted from intervention delivery development to systematic statewide preschool recruitment efforts. Consistent with a combined diffusion and social marketing approach [36], the research team chose a societal sector approach, recruiting through professional organizations, primarily by presenting at and recruiting through regularly scheduled annual conferences, including those sponsored by the South Carolina Association for the Education of Young Children, South Carolina Early Childhood Association, South Carolina Association of Early Care and Education, Head Start Conferences, Live Well Greenville, and Eat Smart Move More. SHAPES participated in an average of six conferences per year, with presentations at four of the conferences and recruiting from a table-only setup at two conferences. The number of participants at the fun and interactive presentations ranged in size from 20 to 200. The presentations were very well received.

Implementation monitoring was guided by the same conceptual model as in the randomized control trial and the translation phase; however, data collection in Phase III was limited to teacher report. This change was appropriate due to the geographically distributed nature of the preschool sites and the future goal of broader geographic dissemination, making observation infeasible.

[Table 2](#) describes the SHAPES products for Phase III, which include the www.goshapes.org website with updated modules, an interactive online community for SHAPES participants and staff, and a video library with 10 sample activities. SHAPES support materials include an updated SHAPES Guidebook, the SHAPES Virtual Activity Binder (including 90 sample activities, “The SHAPES Playbook,” a bank

of movements with descriptions and modifications, and the SHAPES “Active Alphabet,” a reference guide of alphabetical action verbs), updated poster of SHAPES goals (designed to enhance the quality of physical activity opportunities), updated activity cards (three laminated, ring-bound sets, each card with a photo, description of the movement, and tips to increase intensity), updated SHAPES Activity Chart, updated SHAPES Self-Assessment, and SHAPES Community Pinterest Board.

Results

SHAPES is being implemented online by cohort groups and, as of July 2018, nine cohort groups have completed online training, reaching 818 teachers from 228 unique centers across South Carolina. The participating centers include public programs such as Head Start, church programs, private schools such as Montessori, and commercial programs. SHAPES serves any interested program in South Carolina; therefore, the sizes of the programs vary. Six additional cohort groups will be trained by the end of the current funded project in 2019, with an anticipated total reach of 385 centers and 1,375 teachers.

Implementation monitoring results thus far indicate that dissemination and implementation are going well. Most teachers felt prepared to carry out SHAPES: 59% reported they were very prepared, 36% felt somewhat prepared, and most found the online modules (87%), guidebook (80%), sample activities (91%), and activity cards (79%) to be very helpful. Most thought that SHAPES was very worthwhile (72%) or somewhat worthwhile (19%) and plan to use SHAPES fully in the future (62%), with modifications (16%), or to use materials and ideas (22%). Self-reported completeness (85%) and fidelity (child enjoyment = 90% and social environment = 81%) were high and consistent with the Phase II results. Teachers reported that children enjoyed SHAPES (90% “liked or loved”) and 81% report that they encouraged and sometimes or frequently joined in the activities with the children. [Table 1](#) includes a summary of the evaluation design, implementation monitoring methods and results, and feedback and adjustments for Phase III.

DISCUSSION

Advancing public health practice to improve population health requires the accelerated uptake of evidence-based programs, policies, and practices in public health settings, yet research-generated evidence is frequently not relevant to the contextual reality of practice settings [37]. Recommendations to reduce the well-documented gap between research and practice include engaging stakeholders early and throughout the research process, addressing contextual complexity in real-world settings, developing interventions that can be adapted

for better setting fit while retaining the mechanisms of change, and using research and evaluation designs that consider external (i.e., generalizability) as well as internal (i.e., effectiveness) validity [37–40]. The success of SHAPES implementation through the translation and dissemination phases may be due, in part, to attention to these principles.

SHAPES explicitly identified the core elements of an effective intervention, involved preschool teachers early and throughout the translation process, used a flexible approach to implementation that considered preschool teachers’ needs and skills and the varied contexts of preschool settings, and addressed external as well as internal validity in the randomized control trial and throughout the translation process. For example, beginning in the group randomized trial, SHAPES was implemented in the classroom by preschool teachers (i.e., change agents) rather than research staff, with a flexible approach to changing instructional practices, guided by the SHAPES core elements, rather than a prescribed curriculum [30, 31, 33]. Implementation outcomes were measured in all phases (emphasizing external validity), and the SHAPES translation process was designed to maximize population reach.

The Phase I (group randomized trial) attention to stakeholder and setting perspectives, use of a flexible and setting-relevant approach to implementation with a focus on the essential elements (i.e., active ingredients or mechanisms for change) [41], and emphasis on external as well as internal validity enabled the SHAPES team to focus Phase II (translation) efforts on online delivery strategies that would maximize population reach in preschool settings. As a result, the time from establishing the effectiveness of SHAPES (2012) to initiating statewide dissemination of the online professional development delivery approach (2017) was approximately 6 years, considerably less than the often-cited average of 17 years [42].

In summary, we recommend that researchers engage stakeholders early and work with them throughout the process, design the initial program for the real-world setting in which it will be implemented, develop interventions that are flexible and adaptive, use trained setting-based change agents to carry out the program, and carry out comprehensive process evaluation.

Online professional development can be delivered anywhere at any time without travel or taking time from work. SHAPES online training is a flexible delivery approach with the potential to decrease costs and reach large numbers of preschool teachers [20, 22, 43]. Teachers trained to carry out the evidence-based SHAPES intervention can modify instructional practices and alter the preschool classroom environment to promote physical activity, with the potential for increasing physical activity in large numbers of preschool students over

Table 2 | Training components for SHAPES online delivery

Title or theme	Content summary	Modules
1. Physical Activity: The Basics	Provides background knowledge of physical activity (PA), including the importance of PA as it relates to obesity and health in preschool-aged children, benefits of PA, definition of PA and PA intensities, and intensity-specific examples of common physical activities.	
2. Move Inside (MI)	Introduces the three core components of SHAPES (Move Inside, Move Outside, and Move to Learn) and T.I.R.E. strategies (to maximize Time, Intensity, Reach, and Encouragement). In addition, Module 2 explores Move Inside (MI) and provides strategies to effectively implement MI activities and meet the SHAPES daily time goals.	
3. Move Outside (MO)	Describes Move Outside (MO), providing information on how/when to incorporate MO activities, as well as strategies to maximize this SHAPES component using T.I.R.E. strategies and achieve the daily time goal.	
4. Move to Learn (MTL)	Describes Move to Learn (MTL), providing information on how/when to incorporate MTL activities, as well as strategies to maximize this SHAPES component using T.I.R.E. strategies and achieve the daily time goal.	
5. T.I.R.E.	Presents an in-depth look at T.I.R.E., which describes four key factors to maximize physical activity opportunities throughout the school day. Provides teachers with numerous strategies to achieve each factor of T.I.R.E. across all SHAPES components (MI, MO, MTL).	
6. Self-Assessment	Presents a self-assessment tool for teachers to evaluate the implementation and quality of the physical activity opportunities they provide in their classroom. Provides step-by-step instructions for the assessment tool, as well as a review of the content in the previous five modules.	
Quiz for Module 1	Evaluated comprehension of the material covered in Module 1 via 10 multiple-choice questions.	Quizzes
Quiz for Module 4	Evaluated comprehension and application of strategies for MI, MO, and MTL activities presented in Modules 2–4.	Optional Discussion Board
Week 1 PA in your Classroom	In this discussion thread, teachers were encouraged to share two ways to increase the PA intensity of “typical” activities provided in their classroom. In addition, teachers were asked to consider their daily schedule and identify where and when PA opportunities might be implemented.	
Week 2 Move Inside	In this discussion thread, teachers were encouraged to share their experience in implementing MI activities.	
Week 3 Move Outside	In this discussion thread, teachers were encouraged to share their experience in implementing MO activities.	
Week 4 Move to Learn	In this discussion thread, teachers were encouraged to share their experience in implementing MTL activities.	
Week 5 T.I.R.E.	In this discussion thread, teachers were encouraged to share how well the PA opportunities complied with the four elements of T.I.R.E.	
Week 6 SHAPES Self-Assessment	In this discussion thread, teachers were encouraged to share the results of their self-assessment and describe what aspects of implementing PA opportunities went well, identify areas of improvement, and brainstorm ways to improve these opportunities.	

time [19, 20]. Given the numbers of young children in center-based early childhood education and childcare programs [1, 2], dissemination of SHAPES may be an optimal public health strategy for reaching this population [28].

It would have been ideal to include behavioral measures of children's physical activity beyond the randomized control trial; however, because of the geographic spread of the preschool centers involved in SHAPES and the need to prioritize resources, this was not feasible. Similarly, teacher report only was used to assess implementation in the dissemination phase; nevertheless, results from earlier phases showed congruence between observation and self-report. From a public health perspective, facilitating and sustaining organizational change to promote physical activity in settings that serve youth with programs such as SHAPES will expand reach and population impact of physical activity interventions for young children. The next step is to expand the dissemination efforts of SHAPES beyond a single state. SHAPES also provides an effective model for the development and testing, translation, and dissemination of other public health programs.

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Compliance with Ethical Standards

Conflicts of Interest: The authors declare no conflicts of interest.

Human Rights: This article does not contain any studies with human participants performed by any of the authors.

Informed Consent: This study does not involve human participants and informed consent was therefore not required.

Welfare of Animals: This article does not contain any studies with animals performed by any of the authors.

References

- Barnett WS, Friedman-Krauss AH, Gomez RE, Horowitz M, Weisenfeld GG, Squires JH. *The State of Preschool 2015: State Preschool Yearbook*. New Brunswick, NJ: National Institute for Early Education Research. Available at <http://nieer.org/wp-content/uploads/2018/07/State-of-Preschool-2017-Full-7-16-18.pdf>. Accessed May 13, 2019.
- U.S. Department of Education. Institute of Education Sciences, National Center for Education Statistics 2017. Available at https://nces.ed.gov/programs/digest/d17/tables/dt17_202.20.asp?current=yes. Accessed May 13, 2019.
- Buscemi J, Odoms-Young A, Yaroch AL, Hayman LL, Robertson TP, Fitzgibbon ML. Society of Behavioral Medicine (SBM) position statement: SBM supports retaining healthy school lunch policies. *Transl Behav Med*. 2015;5(3):357–359.
- Institute of Medicine (IOM). *Early Childhood Obesity Prevention Policies*. Washington, DC: The National Academies Press; 2011. Available at <http://www.nationalacademies.org/hmd/Reports/2011/Early-Childhood-Obesity-Prevention-Policies.aspx>.
- U.S. Department of Health and Human Services. *Physical Activity Guidelines for Americans*. 2nd ed. Washington, DC: U.S. Department of Health and Human Services; 2018. Available at https://health.gov/paguidelines/second-edition/pdf/Physical_Activity_Guidelines_2nd_edition.pdf. Accessed May 13, 2019.
- Brown WH, Pfeiffer KA, McIver KL, Dowda M, Addy CL, Pate RR. Social and environmental factors associated with preschoolers' nonsedentary physical activity. *Child Dev*. 2009;80(1):45–58.
- Vanderloo LM, Tucker P, Johnson AM, van Zandvoort MM, Burke SM, Irwin JD. The influence of centre-based childcare on preschoolers' physical activity levels: A cross-sectional study. *Int J Environ Res Public Health*. 2014;11(2):1794–1802.
- Dowda M, Brown WH, McIver KL, et al. Policies and characteristics of the preschool environment and physical activity of young children. *Pediatrics*. 2009;123(2):e261–e266.
- Pate RR, Pfeiffer KA, Trost SG, Ziegler P, Dowda M. Physical activity among children attending preschools. *Pediatrics*. 2004;114(5):1258–1263.
- Finn K, Johannsen N, Specker B. Factors associated with physical activity in preschool children. *J Pediatr*. 2002;140(1):81–85.
- McWilliams C, Ball SC, Benjamin SE, Hales D, Vaughn A, Ward DS. Best-practice guidelines for physical activity at child care. *Pediatrics*. 2009;124(6):1650–1659.
- Wolfenden L, Neve M, Farrell L, et al. Physical activity policies and practices of childcare centres in Australia. *J Paediatr Child Health*. 2011;47(3):73–76.
- Trost SG, Messner L, Fitzgerald K, Roths B. Nutrition and physical activity policies and practices in family child care homes. *Am J Prev Med*. 2009;37(6):537–540.
- Ward DS, Vaughn A, McWilliams C, Hales D. Interventions for increasing physical activity at child care. *Med Sci Sports Exerc*. 2010;42(3):526–534.
- Trost SG, Rosenkranz RR, Dzewaltowski D. Physical activity levels among children attending after-school programs. *Med Sci Sports Exerc*. 2008;40(4):622–629.
- National Professional Development Center on Inclusion. *What Do We Mean by Professional Development in the Early Childhood Field?* Chapel Hill, NC: The University of North Carolina, FPG Child Development Institute; 2008. Available at <https://npdci.fpg.unc.edu/resources/articles/NPDCI-ProfessionalDevelopment-03-04-08>. Accessed May 13, 2019.
- Avalos B. Teacher professional development in teaching and teacher education over ten years. *Teach Teacher Educ*. 2011;27(1):10–20.
- Berta W, Cranley L, Dearing JW, Doherty EJ, Squires JE, Estabrooks CA. Why (we think) facilitation works: insights from organizational learning theory. *Implement Sci*. 2015;10:141.
- Bridwell-Mitchell EN. Theorizing teacher agency and reform. How institutionalized instructional practices change and persist. *Sociol Educ*. 2015;88(2):140–150.
- Allen JP, Pianta RC, Gregory A, Mikami AY, Lun J. An interaction-based approach to enhancing secondary school instruction and student achievement. *Science*. 2011;333(6045):1034–1037.
- Lonsdale C, Lester A, Owen KB, et al. An internet-supported school physical activity intervention in low socioeconomic status communities: Results from the activity and motivation in physical education (AMPED) cluster randomized controlled trial. *Br J Sports Med*. 2017;53(6):341–347.
- Lonsdale C, Lester A, Owen KB, et al. An internet-supported physical activity intervention delivered in secondary schools located in low socio-economic status communities: Study protocol for the activity and motivation in physical education (AMPED) cluster randomized controlled trial. *BMC Public Health*. 2016;16:17.
- Kennedy AB, Schenkelberg M, Moyer C, Pate R, Saunders RP. Process evaluation of a preschool physical activity intervention using web-based delivery. *Eval Program Plann*. 2017;60:24–36.
- Yoong SL, Williams CM, Finch M, et al. Childcare service centers' preferences and intentions to use a web-based program to implement healthy eating and physical activity policies and practices: A cross-sectional study. *J Med Internet Res*. 2015;17(5):e108.
- Fitzgibbon ML, Stolley MR, Schiffer LA, et al. Hip-Hop to Health Jr. Obesity Prevention Effectiveness Trial: Postintervention results. *Obesity (Silver Spring)*. 2011;19(5):994–1003.
- Pate RR, O'Neill JR, Brown WH, McIver KL, Howie EK, Dowda M. Top 10 research questions related to physical activity in preschool children. *Res Q Exerc Sport*. 2013;84(4):448–455.
- Gordon ES, Tucker P, Burke SM, Carron AV. Effectiveness of physical activity interventions for preschoolers: A meta-analysis. *Res Q Exerc Sport*. 2013;84(3):287–294.
- Owen N, Glanz K, Sallis JF, Kelder SH. Evidence-based approaches to dissemination and diffusion of physical activity interventions. *Am J Prev Med*. 2006;31(4 Suppl):S35–S44.
- Pfeiffer KA, Saunders RP, Brown WH, Dowda M, Addy CL, Pate RR. Study of Health and Activity in Preschool Environments (SHAPES): study protocol for a randomized trial evaluating a multi-component physical activity intervention in preschool children. *BMC Public Health*. 2013;13:728.
- Howie EK, Brewer A, Brown WH, Pfeiffer KA, Saunders RP, Pate RR. The 3-year evolution of a preschool physical activity intervention through

- a collaborative partnership between research interventionists and preschool teachers. *Health Educ Res.* 2014;29(3):491–502.
31. Pate RR, Brown WH, Pfeiffer KA, et al. An intervention to increase physical activity in children: A randomized controlled trial with 4-year-olds in preschools. *Am J Prev Med.* 2016;51(1):12–22.
 32. Saunders RP, Pfeiffer K, Brown WH, et al. Evaluating and refining the conceptual model used in the study of health and activity in preschool environments (SHAPES) intervention. *Health Educ Behav.* 2017;44(6):876–884.
 33. Howie EK, Brewer AE, Brown WH, Saunders RP, Pate RR. Systematic dissemination of a preschool physical activity intervention to the control preschools. *Eval Program Plann.* 2016;57:1–7.
 34. U.S. Department of Health & Human Services, National Institutes of Health, National Cancer Institute. Making Health Communication Programs Work: A Planner's Guide. 2004. Available at <https://www.cancer.gov/publications/health-communication/pink-book.pdf>. Accessed May 13, 2019.
 35. Saluja G, Early DM, Clifford RM. Demographic Characteristics of Early Childhood Teachers and Structural Elements of Early Care and Education in the United States. Washington, DC: ERIC Clearinghouse; 2002. Available at <https://eric.ed.gov/?id=ED464765>. Accessed May 13, 2019.
 36. Dearing JW, Maibach EW, Buller DB. A convergent diffusion and social marketing approach for disseminating proven approaches to physical activity promotion. *Am J Prev Med.* 2006;31(4 Suppl):S11–S23.
 37. Estabrooks PA, Brownson RC, Pronk NP. Dissemination and implementation science for public health professionals: An overview and call to action. *Prev Chronic Dis.* 2018;15:E162.
 38. Ma J, Lewis MA, Smyth JM. Translational behavioral medicine for population and individual health: Gaps, opportunities, and vision for practice-based translational behavior change research. *Transl Behav Med.* 2018;8(5):753–760.
 39. Brownson RC, Jacobs JA, Tabak RG, Hoehner CM, Stamatakis KA. Designing for dissemination among public health researchers: Findings from a national survey in the United States. *Am J Public Health.* 2013;103(9):1693–1699.
 40. Klesges LM, Estabrooks PA, Dzewaltowski DA, Bull SS, Glasgow RE. Beginning with the application in mind: Designing and planning health behavior change interventions to enhance dissemination. *Ann Behav Med.* 2005;29(Suppl):66–75.
 41. Durlak JA, DuPre EP. Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. *Am J Community Psychol.* 2008;41(3–4):327–350.
 42. Morris ZS, Wooding S, Grant J. The answer is 17 years, what is the question: understanding time lags in translational research. *J R Soc Med.* 2011;104(12):510–520.
 43. Muñoz RF. Using evidence-based internet interventions to reduce health disparities worldwide. *J Med Internet Res.* 2010;12(5):e60.