

A Theory-Informed Pre-Implementation Enhancement Strategy Targeting Mechanisms and Outcomes of Implementation: A Triple-Blind Randomized Controlled Trial

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Abstract

Background

As the most common setting where youth access behavioral health services, the education sector frequently employs training and follow-up consultation as cornerstone implementation strategies to promote the implementation of evidence-based practices (EBPs). However, these strategies alone are not sufficient to promote desired implementation (e.g., intervention fidelity) and youth behavioral health outcomes (e.g., mitigated externalizing behaviors). Theory-informed pragmatic pre-implementation enhancement strategies (PIES) are needed to increase the yield of training and consultation. Specifically, social-cognitive theory explicates principles that inform the design of PIES content and specify mechanisms of behavior change (e.g., "*intentions to implement*"; ITI) to target to increase providers' responsiveness to training and consultation.

Methods

This triple-blind parallel randomized controlled trial preliminarily examined the efficacy of a pragmatic PIES based on social-cognitive theories (SC-PIES) to improve implementation and youth behavioral outcome from universal EBPs in the education sector. Teachers from a diverse urban district were recruited and randomly assigned to either the *treatment* (SC-PIES; $n_{\text{treatment}} = 22$) or *active control* condition (administrative meeting; $n_{\text{control}} = 21$). Based on the condition assigned, teachers received the SC-PIES (or met with administrators) before EBP training. We assessed teachers' ITI, intervention fidelity, and youth behavioral outcome (academic engagement as an incompatible behavior to externalizing disorders) at baseline, immediately after training, and six weeks afterward.

Results

A series of ANCOVAs detected sizeable effects of SC-PIES, where teachers who received SC-PIES demonstrated significantly larger improvement in their ITI, intervention fidelity, and youth behaviors as compared to the control. Conditional analyses indicated that teachers' ITI partially mediated the effect of SC-PIES on intervention fidelity, which in turn led to improved youth behaviors.

Conclusions

Findings suggest that theory-informed pragmatic PIES targeting providers' ITI can potentially boost their responsiveness to implementation strategies, as reflected in improved implementation behaviors and youth behavioral health outcomes. The results have implications for targeting motivational mechanisms of behavior change and situating implementation strategies at the intersection between preparation and

active implementation stages of an implementation process. Limitations and implications for research and practice are discussed and extended to general youth behavioral health settings.

Trial registration:

Clinicaltrials.gov: NCT05240222. Registered on: 2/14/2022. Retrospectively registered.

<https://clinicaltrials.gov/show/NCT05240222>

Contributions To The Literature

- Pragmatic pre-implementation enhancement strategies (PIES) grounded in social-cognitive theory have the potential to increase the yield of training and consultation on providers' implementation behaviors and service recipient outcomes.
- This study contributes to the growing body of research advocating that implementation strategies should be developed and tested to operate on specific malleable mechanisms of behavior change (e.g., intentions to implement) and that implementation strategies can be both pragmatic and effective.
- This study highlights the importance of situating motivation-focused implementation strategies at the immediate intersection of the preparation and active implementation stages of the implementation process.

Background

Across virtually every service sector, training and follow-up consultation are cornerstone implementation strategies designed to promote provider uptake and use of evidence-based practices (EBPs; 1). While training and consultation are essential implementation strategies, there is mounting evidence indicating that these strategies alone are insufficient to translate what is known to work in research into routine practices that ultimately improve service recipient outcomes (2, 3). Pre-implementation enhancement strategies (PIES) that complement and increase the yield of training and follow-up consultation are needed, particularly ones that are pragmatic and theoretically informed to target precise mechanisms of behavior change (4, 5). PIES that bolster the yield of implementation strategies is especially needed in the context of youth behavioral health where many youth in need of care do not access quality prevention or treatment services even though numerous EBPs exist (6, 7). The education sector is one of the best settings to develop and test PIES as it is the most common setting where youth access behavioral health services (8, 9, 10). With a triple-blind parallel randomized controlled trial, this study aimed to test a pragmatic PIES designed with principles rooted in social-cognitive theories (SC-PIES) as a complement to EBP training and follow-up consultation to enhance teachers' intentions to implement and implementation outcomes in the service of producing better youth behavioral health outcomes in the education sector.

Youth Behavioral Health and EBPs in the Education Sector

As a prevalent and impactful youth behavioral health problem, externalizing behavioral disorder and its prevention and treatment remain top priorities for policymakers, researchers, and healthcare professionals in the education sector (11). Externalizing behavioral health problems are outer-directed behaviors that harm relationships with others and violate social norms and rules (12). Youth who exhibit externalizing behavioral problems are likely to experience negative outcomes, including academic difficulties (13), strained relationships with others (14), elevated risk for dropout (15), substance abuse (16), repeated exposure to exclusionary discipline practices and contact with the juvenile justice system (17). To prevent these untoward outcomes, researchers have established several EBPs for use in the educational sector. For example, proactive classroom behavior management (PCBM) includes a suite of EBPs that are prevention-oriented and aim to promote high levels of behavioral engagement in class as incompatible with externalizing behavior problems (18). Extant research has established the effectiveness of various PCBM practices for consistent use by teachers in the context of classrooms where youth spend significant amounts of time (19). PCBM practices promote youth's behavioral and academic success in class that leads to short-term success in school (e.g., reduced externalizing behaviors, increased academic achievement, and school engagement; 20,21). These short-term outcomes are determinants of longer-term beneficial outcomes that reach into adulthood (22). Although PCBM practices have been disseminated through multiple outlets (e.g., refereed journals, books, and media outlets), passive implementation efforts have proven insufficient to produce scalable changes in teachers' delivery of PCBM practices (23).

Teachers as Primary Implementers with Varied Response to Training and Consultation

In the education sector, the implementation of universal, prevention-oriented EBPs targeting youth behavioral health outcomes are primarily the responsibility of classroom teachers who spend the most time during the school days interfacing with youth (5). For this reason, teachers are the recipients of training and consultation, which are the most common implementation strategies used to promote teachers' uptake and delivery of universal EBPs (3). While training and follow-up consultation are considered core implementation strategies, these strategies alone are insufficient to produce quality and consistent implementation across implementers. For example, didactic trainings are necessary to increase knowledge of practices, but they are ineffective alone in producing changes in teachers' classroom practices (24). Moreover, teachers may demonstrate resistance or ambivalence to change when receiving follow-up support such as consultation (5).

As primary implementers, teachers' motivation plays an instrumental role in determining whether they will respond to training and follow-up consultation to initially adopt then persist towards using an EBP with fidelity (25). Indeed, teachers are a heterogeneous group of implementers who vary significantly according to motivational factors that influence whether they are likely to adopt new practices as part of

their regular classroom routines (26,27). Variability in motivational determinants of change exists regardless of whether teachers work in school settings with optimal organizational determinants in place (e.g., supportive leadership, quality training, and coaching; 28). Therefore, there is a need for complementary pre-implementation strategies that occur before training and consultation to target motivational determinants of behavior change to enhance teachers' responsiveness to training and consultation (29).

Pre-Implementation Enhancement Strategies to Improve Responsiveness to Training and Consultation

Theory-informed and pragmatic pre-implementation enhancement strategies (PIES) offer promise as complementary strategies that can increase the yield of training and follow-up consultation on both implementation and youth behavioral health outcomes. PIES occur before more active implementation supports such as training and consultation. EBP training and consultation more directly focus on increasing providers' knowledge of and follow through with specific practices. A common implicit assumption of training and consultation is that providers are already motivated to change their behaviors. However, this is not always the case. PIES occur before providers participate in training and consultation activities and are designed to motivate and prime providers to engage and respond more to active implementation strategies. Essentially, PIES sits at the immediate intersection of the preparation and active implementation phases of an implementation process (30).

Consistent with recommendations for developing implementation strategies (31), the development of PIES should be grounded in theory to ensure the content targets precise motivational mechanisms of behavior changes before receipt of training and consultation. Theoretically, effective PIES can enhance providers' motivational mechanisms (e.g., intention to implement), which in turn improve their responsiveness to EBP-specific implementation strategies (e.g., training and consultation) that lead to enhanced implementation outcomes (e.g., adoption, fidelity) that ultimately optimize youth behavioral outcomes.

Use of Social-Cognitive Theory to Develop and Test PIES

Applied social-cognitive theory and research offer principles and evidence that could inform the development of pragmatic and effective PIES (32). In the context of implementation, strategies informed by social-cognitive theory could serve to alter teachers' perceptions and motivation regarding the uptake and use of EBPs, in the context of actively acquiring knowledge about them (training) and participating in ongoing support and feedback to deliver them with fidelity (consultation). Social-cognitive research suggests that implementers' behavioral intentions are malleable mechanisms of behavior change that can be targeted via intervention (33). The Theory of Planned Behavior (TPB; 34,35) is a widely established social-cognitive theory that has been used to predict and target behavior change (36). The

central tenet of the TPB is that one of the best predictors of behavior is a person's behavioral intentions. Behavioral intentions "capture the motivational factors that influence a behavior; they are indicators of how hard people are willing to try, of how much effort they are planning to exert, in order to perform the behavior" (34). Previous research using the TPB has shown that implementation strategies targeting implementers' behavioral intentions are linked to improved implementation outcomes during the active implementation phase when EBP uptake and use are critical (e.g., 37-39). Moreover, a study conducted with teachers serving youth with autism indicated that, following in-service training, teachers endorsing high intentions to implement were five times more likely to adopt and deliver EBPs than teachers endorsing low intentions to implement (40). As such, implementation strategies that target behavioral intentions before initiating active implementation may serve as an effective approach to increase teachers' responsiveness to training and consultation.

Several empirically established social-cognitive principles can be used to guide the content development of a PIES (39,35). We strategically selected three social-cognitive principles based on two criteria: (1) empirical evidence related to behavior change and (2) ease of designing content and activities that are perceived as acceptable and pragmatic by teachers. First, the principle of *growth mindset* was selected as it is a popularized construct that has gained widespread attention in education and can be leveraged for purposes of face validity to engage teachers (41). Research has shown that people's mindsets or implicit theories about the malleability of their cognitive and physical abilities have significant impacts on their goals, effort, and performance (42).

Second, the *saying-is-believing* principle was selected, because it involves individuals advocating for an idea or action to others to increase their own commitment to the idea or action regardless of their initial beliefs about it (43). For instance, college youth randomly assigned to write letters to incoming youth endorsing the importance of overcoming social and academic adversity and using problem-solving strategies to do so showed significant improvements in their own school-related behaviors and achievement (44). Teachers who are provided with opportunities to advocate ideas relevant to adopting and implementing new practices may in turn exhibit greater intentions to implement and are more likely to implement once they receive training and follow-up consultative support (45).

Last, we selected the principle of *commitment and consistency* (46), which involves evoking a state of psychological and emotional tension that gets activated when individuals recognize a discrepancy between a belief and their behavior. The tension and discrepancy lead to an increased likelihood of individuals striving to maintain consistency between their beliefs and actions (46). Specific desired behaviors (i.e., intervention fidelity) can be increased by evoking commitments that are active, public, and voluntary (47). Once individuals make a commitment, they are more motivated to maintain consistency between their beliefs and actions (i.e., commitment or follow through with the stated action). Research has leveraged this principle to induce cognitive dissonance to promote behavior change (48). This technique has been applied to a wide range of behaviors, including voting behavior, fund-raising, and recycling (49,50).

Study Aims

There is limited research on the development and evaluation of PIES as complementary strategies that aim to increase the yield of training and consultation on both implementation and youth behavioral health outcomes. Moreover, the literature on implementation strategies from other service sectors has largely neglected the specification of change mechanisms by which strategies impact implementation and client outcomes (51). A focus on theory-informed mechanisms as mediators of behavior change is vital to identifying why and how implementation strategies (e.g., PIES) work, which can subsequently inform the development, testing, and refinement of effective implementation strategies (52,35). Such inquiries must be informed by valid theories to explain how strategies at different implementation stages (e.g., pre- vs active implementation) influence implementation and youth behavioral health outcomes (53). In the current study, we experimentally examined the efficacy of a pragmatic PIES based on social-cognitive theories (SC-PIES) to influence a putative mechanism of behavior change (intentions to implement), implementation outcomes, and an important youth behavioral health outcome (academic engagement as an incompatible behavior to externalizing disorders). Specifically, we conducted a preliminary triple-blind parallel randomized controlled trial to address four research questions:

- (1) As compared to control, does SC-PIES significantly improve teachers' implementation intentions to implement PCBM practices at posttest after adjusting baseline and covariates?
- (2) As compared to control, is receiving SC-PIES associated with significantly improved teachers' intervention fidelity and class-wide youth behavioral health outcome at the 6-week follow-up after adjusting for baseline and covariates?
- (3) Does teachers' *intention to implement* mediate the association between study condition and intervention fidelity?
- (4) Does teachers' intervention fidelity mediate the association between their *intentions to implement* and class-wide youth behavioral health outcome?

Method

Setting and Participants

This study took place at two elementary schools in a large and diverse urban district in the Pacific Northwest of the U.S. The district was in the first year of a district-wide implementation initiative for a universal prevention program for youth behavior health. The two participating schools had no experience implementing universal prevention programs targeting youth behaviors before the study. Teachers were recruited if they completed less than two trainings about or have experience implementing the Proactive Classroom Behavioral Management Strategies (PCBM) prior to this study. Of the 43 participating general education teachers, the majority were White ($n = 29$; 67.4%) and female ($n = 35$; 81.4%). The average teaching experience was 8.7 years ($SD = 6.4$) and about a third had a master's degree ($n = 14$, 32.55%;

Table 1). Twenty-two teachers reported taking one pre-service training about PCBM while the remaining ($n = 19$) had no formal training or implementation experience, which is consistent with the education literature (54).

Procedures

This study was approved by the university IRB and the evaluation department of the partnering district. First, school administrators met with teachers to introduce the study on classroom management practices, answer questions, then connect interested teachers to the research team to obtain their consents. Forty-three teachers were recruited and consented to participant. With an online random number generator (55), a graduate assistant, who did not participate in data collection, analysis, or reporting, randomly assigned teachers to the treatment ($n_{\text{treatment}} = 22$) or control condition ($n_{\text{control}} = 21$). The triple-blind design ensured that none of the participants, researchers, or observers who assess outcomes were unaware of the results of random condition assignment. This study rolled out in multiple steps in the Fall semester as depicted in the CONSORT diagram (Figure 1; 56). The STARi and CONSORT Checklists are included as additional files 2 and 3. First, pre-test data were collected from all participants about the putative mechanism, intentions to implement (ITI), both implementation (intervention fidelity) and youth behavioral outcomes (academic engaged time; AET). Then participants in the treatment condition received the SC-PIES, while participants in the active control condition met with their administrators for the same duration as the SC-PIES.

Two days after the SC-PIES and the meeting with administrators, participants from both conditions received two 2-hour training sessions for two consecutive days about four proactive classroom management strategies (PCBMs; Additional file 1). The training sessions followed a *tell-show-do* approach, where the teachers received instruction about PCBMs, watched the various components modeled by the trainer, and were provided opportunities to rehearse and plan the implementation of the PCBMs. At the end of each training sessions, teachers received one-on-one performance-based feedback from the trainer. The post-test of ITI were conducted immediately after the EBP training because social cognitive theories support that implementers' intention, as a predictor of their subsequent behavioral change, can be most effectively assessed before their actual enactment of implementation behaviors (39). In the following weeks, consultants provided follow-up consultations to participants on two separate occasions (one- and four-week post-training). Six-week follow-up data was collected on intervention fidelity and AET. To enable appropriate causal inference, the multi-step procedure separated and sequenced the temporal orders of the PIES (at pre-implementation stage), putative mechanism (intentions to implement before behavioral enactment), implementation supports (training and consultation), implementation behavior (intervention fidelity) and youth behavioral outcome (AET).

Pre-Implementation Enhancement Strategy Informed by Social Cognitive Theory (SC-PIES)

The SC-PIES was delivered to teachers as a one-hour professional development session immediately before receiving training about evidence-based PCBM practices and follow-up consultation. The SC-PIES was designed to maximize its pragmatism where all content and activities can be delivered to a group of implementers in 60 minutes. SC-PIES content was grounded in three social-cognitive principles: (a) *growth mindset*, (b) *saying-is-believing*, and (c) *commitment and consistency*.

Growth Mindset. Consistent with prior research, growth mindset was not directly implicated as something teachers need to acquire and exhibit. Instead, the growth mindset component of SC-PIES was modeled after prior research (57), where teachers learned about neuroplasticity (i.e., the brain can change with effort and persistence to engage in growth-oriented experiences) as it relates to youth development. Specifically, teachers first watched two videos then were prompted to engage in guided reflective discussion with colleagues. During the discussion, teachers were encouraged to (a) explore the implications of neuroplasticity for promoting youth's growth, enabling them to persevere in the face of adversity when learning new knowledge and skills; (b) discuss ways they could encourage youth to internalize the notion of neuroplasticity. Next, the facilitator led a whole-group discussion with teachers to share their responses. Overall, the growth mindset component of SC-PIES attempted to instill in teachers a practice-oriented notion of growth mindset toward PCBM, where we encouraged teachers to act as role models for youth through their own efforts to learn new things and persevere through adversity.

Saying-Is-Believing. Building on the growth mindset component and prior research (43), the *saying-is-believing* component of the SC-PIES involved teachers writing letters to new teachers in which they explained the concept of neuroplasticity and illustrated the concept by describing how they were able to overcome challenges as a new teacher to learn new practices and better manage the conditions of running a class. Specifically, they were instructed to describe a real-life scenario where they experienced adversity as new teachers but were able to overcome it by stretching themselves and putting in the effort to learn and apply a new practice. This activity put teachers in the role of mentors for new teachers and encouraged them to advocate a message about learning new things and expressing the positive outcomes associated with increased effort and persistence. Teachers were instructed that these letters would be shared with the new teachers as a way of normalizing common difficulties and emphasizing the importance of effort and perseverance to learn new skills over time as a teacher.

Commitment and consistency. The last component of SC-PIES involved encouraging teachers to make public commitments regarding supporting youth's growth mindsets. Based on the commitment and consistency principles (33), this strategy hypothesizes that once individuals have made a public and explicit commitment, their beliefs tend to shift to maintain consistency between their commitment and actions. Teachers were asked to publicly sign a billboard that would be posted for youth and parents to see that read, "At our school, we believe in our youth's ability to grow their brains and academic skills through hard work, putting in extra effort to learn new skills, seeking assistance when confronted with challenges and persevering in the face of failure through the feedback we provide them and modeling effort and perseverance ourselves." In addition to posting the billboard in a highly visible area near the

school office, a photocopy of the signed billboard was sent out to every teacher in the treatment condition to post it as a reminder in their immediate environments (e.g., office or classrooms).

The Evidence-Based Proactive Classroom Behavioral Management Strategies (PCBM)

Based on a consensus-driven approach facilitated by school administrators, staff at the school selected four evidence-based PCBM practices as non-negotiables to implement across every classroom (additional file 1), including (1) greeting youth at the door, (2) behavior-specific praise, (3) providing numerous opportunities to respond, and (4) post, teach, review, and provide feedback about positively stated behavioral expectations (PTRP).

Measures

Intentions to Implement (ITI)

The Modified Intentions to Use Scale was adopted to assess teachers' intentions to implement new EBPs (37). The scale is originally developed from research on practitioners' intention to adhere to measurement-based care and is consistent with the recommendations for assessing behavioral intentions based on the theory of planned behavior (34). The scale consists of five items on a 7-point Likert scale ranging from "greatly disagree" to "greatly agree". The items were modified to specifically assess teachers' intentions to implement EBPs. The scale showed acceptable reliability and validity in prior research (58) and the current study ($\alpha = .75$; 57).

Intervention Fidelity

A team of trained professionals, who were blinded to the random assignment results, conducted structured observations to assess intervention fidelity, which is operationalized in this study as "*adherence to core components of the classroom management practices*." The data collection took place at pre-test and 6-week follow-up to allow enough time to detect and compare changes in fidelity. First, during core instructional times, trained observers observed two occasions at pre-test and 6-week follow-up to code the presence or absence of the core components of the PCBM. Immediately following the observations, these observers completed a fidelity rating rubric, which was created by operationalizing three core components of each PCBM such that observers could reliably observe and rate them (59). The average of the observation coding and the rubric scores represents each teacher's fidelity. Acceptable inter-rater reliability (IRR; Spearman correlations) were found for all four PCBM (Mean $r = .79$), which was based on ratings from two observers for the same teacher for 20% of the same occasion.

Academic Engaged Time (AET)

AET was defined as "any instance where youth are attending to instruction, watching the teacher or speaker, or concentrating on their classwork". This study used Direct Behavior Ratings (DBRs) for academic engaged time (AET) with which a teacher observes a youth's AET throughout a predetermined interval. Teacher-completed DBRs demonstrated strong correlations to Structured Direct Observations in assessing AET ($r = .81$; 60). The DBRs were completed at pre-test and 6-week follow-up. For comparability across classrooms, each teacher completed DBRs during the reading/language arts block at the same time each day of the week for five randomly selected youth, whose results were then averaged for that class. This approach has demonstrated adequate reliability and validity to capture class-wide AET (60). To secure the temporal sequences in the mediation analyses, the AET was measured after intervention fidelity at six-week follow-up.

Data Analysis

First, assumptions for all planned analyses were tested and generally met (e.g., normality of residuals and homoscedasticity). Then, Chi-square tests and independent-samples t -tests were performed to assess baseline equivalences between the study conditions in the pre-test values of teachers' demographics (experience, grade, ethnicity, and gender), and three dependent variables (DVs; teachers' ITI, intervention fidelity, and class-wide AET). For RQs 1 and 2, we used ANCOVA to estimate the treatment effect of SC-PIES on each of the three DVs. The ANCOVA models were configured the same way where the post-treatment score of a DV was regressed on the binary variable of study condition (reference category = control) as the foci predictor, while controlling for the pre-test score of the DV and demographics as covariates. The literature generally supported ANCOVA as the most appropriate and informative treatment effect analytic approach for pre/post control group designs because it can enable (a) adjustment of the pre-test score as a covariate because it is not an outcome by definition; (b) convenient and interpretable adjustment of other baseline covariates or confounding variables; (c) handling of complex heteroscedasticity patterns in the general linear model framework (61). To adjust for the bias caused by the covariance matrix heterogeneity of the parameter estimates and the small sample, we used the heteroskedasticity-consistent standard error estimator (HC4;62). Given the relatively small sample and multiple tests performed, traditional null hypothesis tests with p -values are suboptimal (i.e., inflated type I error). The FDR-corrected p -values (false discovery rate; q -values) were estimated to correct for potential false positives with an intended level of significance corresponding to $q = .05$ (63,64). Power analysis was performed with the G*Power version 3.19 (65). Given the sample of 43, six predictors, and alpha level of .05, we will have sufficient power ($\geq .80$) to detect a minimum detectable effect sizes (MDES; Cohen's d) as small as .19.

To examine the hypothesized change mechanisms of SC-PIES (RQs 3 and 4), we sequentially explored the mediation effect of ITI on the relationship between study conditions and intervention fidelity, followed by a secondary model where teachers' fidelity was hypothesized to mediate the relationships between

their ITI and class-wide AET. To control for baseline status, the mediation models were fitted with change scores that were calculated by subtracting pre-test values from post-test (66). The nonparametric bootstrapping mediation analysis was used rather than the causal steps approach (67) because of its superior capacities to handle small samples, estimate robust standard errors, and detect mediation effects without significant total effects (68). We interpreted results based on statistical significances and standardized mean differences with pooled pretest standard deviations (SMDES; 69). The SMDES is interpreted as the units of standard deviations of the mean difference between the pre- vs post-test changes of teachers' outcome in the treatment condition and those in the control. All analyses were performed with SPSS version 26 (70).

Results

Treatment Effects of SC-PIES (Research Questions; RQs 1 and 2)

The t-tests confirmed that the random assignment created probabilistically equivalent groups in terms of the baseline status of key variables ($n_{\text{treatment}} = 22$; $n_{\text{control}} = 21$. Table 2). For the ANCOVA on teachers' ITI (RQ 1; Table 3), results showed a significant positive effect of SC-PIES where the post-treatment scores of teachers' ITI in the treatment condition were significantly higher than the scores of those in the control ($b = 2.18$, $p < .01$). The standardized mean difference effect size (SMDES) was .40. Of note, teachers' work experience ($b = -0.13$, $p < .05$) was a significant predictor of post-treatment scores of their ITI, which suggests that one year increase in experience is associated with 0.13 unit decrease in the scores of teachers' ITI controlling for everything else.

For the ANCOVA on intervention fidelity (RQ 2; Table 3), results indicated that the intervention fidelity of teachers in the treatment condition was significantly higher than the fidelity of those in the control at 6-week follow-up ($b = 2.39$, $p < .001$). The SMDES for fidelity was .91. For class-wide AET (RQ 2; Table 3), results indicate that youth's AET in the classrooms of the teachers from the treatment condition was significantly higher than that of the teachers from the control ($b = 0.06$, $p < .01$). The SMDES for AET is .47. No demographic covariates were significant for either fidelity or AET.

Mediational Mechanisms of Change (RQs 3 and 4)

For teachers' ITI, we first fitted Model 1 by entering the binary variable of study condition as the predictor (reference = control), the change score of ITI as the mediator, and the change score of intervention fidelity as the outcome (Table 4; Figure 2A). Results indicated that SC-PIES exerted a significant direct effect (DE) on the changes in teachers' fidelity (DE=1.21, $p < .05$). Also, a positive indirect/mediation effect (IE) was detected where changes in teachers' ITI partially mediated the relationship between condition and fidelity (IE= 1.04, 95% CI = [40, 1.80]). This finding suggested that teachers who received the SC-PIES demonstrated greater improvement in their intentions to implement PCBM, which in turn enhanced their

fidelity of PCBM, as compared to those in the control condition. For Model 2 (Table 4; Figure 2B), results indicated that teachers' fidelity was a significant positive mediator between their ITI and youth' AET (IE= 0.02, 95% CI = [0.01, 0.03]). However, the total and direct effects of teachers' ITI on their youth' AET were non-significant (TE = 0.01, $p > .05$; DE= - 0.01, $p < .001$). This constitutes a special phenomenon called inconsistent mediation where a significant mediation effect is present without a significant total effect and the signs of the direct versus indirect effects are opposite (71).

Discussion

There is a need for complementary pre-implementation enhancement strategies (PIES) that serve as adjuncts to training and consultation. This study offers preliminary evidence for a PIES based on social cognitive theories (SC-PIES) that was designed to be pragmatic (e.g., 60-minute group delivery) and target a precise motivational mechanism of behavior change (intentions to implement; ITI) before a group of providers received EBP-specific training and follow-up consultation. Specifically, using a triple-blind parallel randomized controlled trial, this study found that the pragmatic SC-PIES was effective at boosting teachers' responsiveness to EBP-specific training and consultation as evidenced by improved ITI, intervention fidelity and youth behavioral health outcomes (i.e., behavioral academic engagement as an incompatible response to externalizing problems).

Findings also provide preliminary support for the mechanism of intentions to implement. The SC-PIES appears to function by first enhancing teachers' intentions to implement EBPs, which in turn lead to higher levels of intervention fidelity. Higher levels of intervention fidelity were then associated with improvements in an important youth behavioral health outcome (i.e., behavioral academic engagement). The findings are consistent with previous research on the theory of planned behavior indicating implementers' intentions as a potential change mechanism that leads to increased intervention fidelity (40). The partial mediation effect implied that teachers' intentions to implement new EBPs are important to target before receiving specific training and consultation about those EBPs.

Furthermore, the inconsistent mediation effect of fidelity (71) echoes with the emerging research on mechanisms of change involving hypothesized causal association between service providers' cognition, implementation behavior, and client outcomes (e.g., 36,51,58). Specifically, the significant direct and indirect effects with a non-significant total effect imply potential alternative effect pathways besides fidelity (e.g., unmeasured mediators or moderators) that could explain how teachers' intention to implement an EBP can influence youth outcomes. Future research should explore alternative pathways through which certain mechanisms of change associated with providers' cognition (e.g., self-efficacy and subjective norms) impact youth outcomes of interests in addition to common implementation outcomes (35).

Implications for Research and Practice

This study is among a growing body of research to investigate a PIES at the immediate intersection between the preparation and active implementation stages of the implementation process. Our findings demonstrated the utility of social-cognitive theories in general (35), and the TPB specifically (34) to inform the design of PIES. Our findings corroborated prior research (e.g., 5, 57) by supporting the promise of pre-implementation strategies targeting teacher intentions to implement as malleable mechanisms to target via pre-implementation strategies that have the potential to lead to better implementation and client outcomes. In addition, findings suggest that intentions to implement could serve as a tailoring variable to differentiate the intensity of implementation supports. For teachers with weak pre-training intentions, PIES can be used to boost their intentions to implement EBPs, which has the potential to increase providers' engagement with and responsiveness to training and consultation supports. For teachers with strong pre-training intentions, active implementation support alone (e.g., training) may serve as an effective strategy to produce successful implementation (72). Future research should explore such a precision-based approach to tailor implementation strategies that are adaptive to individual characteristics as a cost-effective way to improve their implementation and client outcomes through methodologies such as SMART designs (73,74). Research spanning several fields (e.g., healthcare, community-based mental health) indicates that tailored strategies are more likely to produce superior implementation and client outcomes than a one-size-fits-all approach (75).

Implementation researchers have argued that the field is at risk for replicating the problem it seeks to avoid (i.e., the science-to-practice gap) by creating a divide between implementation science and practice (76). The complexity, costs, and expertise required to deliver implementation strategies impacts whether these strategies can be feasibly transferred into routine practice (77). Too often researchers develop strategies that are unlikely to be adopted and used under natural conditions to support EBP implementation. This compounds the science-to-practice gap. The brevity and intuitiveness of the PIES in this study were intentional to ensure that it was pragmatic and fits the educational context regarding the scarcity of time available for teachers to participate in professional learning opportunities. A focus on the pragmatics of implementation strategies increases the potential for translation into real-world implementation efforts if effectively disseminated.

Limitations and Future Directions

Several limitations should be considered when interpreting the findings of this study. First, the findings may be limited to the specific type of practices that were the focal EBPs in this study, which are aligned well with teachers' job roles and expectations (i.e., PCBM). It is unclear whether findings would generalize to other EBPs, particularly ones that may be more complex and demanding regarding learning and time investment. Certain implementation strategies and EBPs may be better suited for PIES. Second, this study only sampled teachers from elementary schools. Findings need to be replicated in other educational contexts with diverse samples of professionals (e.g., counselors at university clinics) and other behavioral health service sectors with different provider groups (e.g., clinicians in hospitals). Relatedly, although our findings supported the efficacy of the SC-PIES, not all teachers demonstrated changes in

response to the SC-PIES on the mechanism of change (i.e., intentions to implement), implementation outcome, and youth outcome. Future research should explore moderators (e.g., providers' and clients' demographics, individual implementation determinants such as stress or burnout) that elucidate for whom PIES works to guide a tailored approach to implementation support.

Conclusion

This study offers insights into how to design theory-informed and pragmatic PIES to boost the yield of training and consultation on providers' EBP adoption and fidelity to achieve better client outcomes in various youth behavioral health settings. The findings from this triple-blind randomized controlled trial highlight the importance of mechanistic approaches to developing and testing implementation strategies, especially those grounded in social-cognitive theories. We encourage researchers to investigate cost-effective ways to elevate providers' motivation as a crucial mechanism linked to their engagement and responsiveness to common implementation strategies such as training and consultation. Last, we hope this study stimulates more researchers to develop and test motivationally focused PIES that are situated at the immediate intersection between the preparation and active implementation stages of the implementation process.

Abbreviations

PIES: Pre-implementation enhancement strategies. SC-PIES: social-cognitive theory-informed pre-implementation enhancement strategies. EBP: evidence-based practice. TPB: Theory of Planned Behavior. ITI: intentions to implement. AET: Academic engaged time.

Declarations

Ethics approval and consent to participate: Informed consent was obtained from all individual participants in the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (University of Washington Human Subject Division, HSD52139EG) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent for publication: Not applicable

Availability of data and material: The de-identified datasets generated and analyzed during the current study are available in the *Open Science Framework* repository, [osf.io/d5t4m/].

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Authors' contributions: YZ developed and finalized the manuscript, analyzed, and interpreted the data, and created all supportive materials. CRC was a major contributor to the manuscript and carry-out of the study. The other authors all helped coordinate the trials and made significant contribution to writing and editing the manuscript. All authors read and approved the final manuscript.

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References

1. Lyon AR, Pullmann MD, Walker SC, D'Angelo G. Community-sourced intervention programs: Review of submissions in response to a statewide call for "promising practices". *Adm Policy Mental Health Mental Health Serv Res.* 2017;44(1):16–28.
2. Powell BJ, Beidas RS, Lewis CC, Aarons GA, McMillen JC, Proctor EK, et al. Methods to improve the selection and tailoring of implementation strategies. *J Behav Health Serv Res.* 2017;44(2):177–94.
3. Edmunds JM, Beidas RS, Kendall PC. Dissemination and implementation of evidence-based practices: Training and consultation as implementation strategies. *Clin Psychol Sci Pract.* 2013 Jun;20(2):152.
4. McLeod BD, Cox JR, Jensen-Doss A, Herschell A, Ehrenreich-May J, Wood JJ. Proposing a mechanistic model of clinician training and consultation. *Clinical Psychology: Science and Practice* 2018;25(3):e12260.
5. Lyon AR, Cook CR, Duong MT, Nicodimos S, Pullmann MD, Brewer SK, Gaias LM, Cox S. The influence of a blended, theoretically-informed pre-implementation strategy on school-based clinician implementation of an evidence-based trauma intervention. *Implement Sci.* 2019 Dec;14(1):1–6.
6. Phillippi S, Beiter K, Thomas C, Vos S. Identifying gaps and using evidence-based practices to serve the behavioral health treatment needs of medicaid-insured children. *Child Youth Serv Rev.* 2020;115:105089.
7. Williams NJ, Beidas RS. Annual research review: The state of implementation science in child psychology and psychiatry: A review and suggestions to advance the field. *J Child Psychol Psychiatry.* 2019;60(4):430–50.
8. Duong MT, Bruns EJ, Lee K, Cox S, Coifman J, Mayworm A, et al. Rates of mental health service utilization by children and adolescents in schools and other common service settings: A systematic review and meta-analysis. *Adm Policy Ment Health.* 2021 May 1;48(3):420–39.
9. Weist MD, Bruns EJ, Whitaker K, Wei Y, Kutcher S, Larsen T, Holsen I, Cooper JL, Geroski A, Short KH. School mental health promotion and intervention: Experiences from four nations. *School Psychol Int.* 2017 Aug;38(4):343–62.
10. Fazel M, Hoagwood K, Stephan S, Ford T. Mental health interventions in schools in high-income countries. *Lancet Psychiatry.* 2014 Oct;1(5)(1):377–87.

11. Office of the Surgeon General. Protecting Youth Mental Health: The US Surgeon General's Advisory [<https://www.hhs.gov/surgeongeneral/reports-and-publications/youth-mental-health/index.html>].
12. Splett JW, Garzona M, Gibson N, Wojtalewicz D, Raborn A, Reinke WM. Teacher recognition, concern, and referral of children's internalizing and externalizing behavior problems. *School Mental Health*. 2019;11(2):228–39.
13. Lee P, Bierman KL. Classroom and teacher support in kindergarten: Associations with the behavioral and academic adjustment of low-income students. *Merrill-Palmer quarterly (Wayne State University Press)*. 2015 Jul;61(3):383.
14. Leflot G, van Lier PA, Verschueren K, Onghena P, Colpin H. Transactional associations among teacher support, peer social preference, and child externalizing behavior: A four-wave longitudinal study. *J Clin Child Adolesc Psychol*. 2011 Jan;11(1):87–99. 40(.
15. Bevilacqua L, Hale D, Barker ED, Viner R. Conduct problems trajectories and psychosocial outcomes: a systematic review and meta-analysis. *European child & adolescent psychiatry*. 2018 Oct;27(10):1239–60.
16. Regan T, Tubman JG, Schwartz SJ. Relations among externalizing behaviors, alcohol expectancies and alcohol use problems in a multi-ethnic sample of middle and high school students. *Subst abuse: Res Treat*. 2020;14:1178221820928427.
17. Mitchell MM, Bradshaw CP. Examining classroom influences on student perceptions of school climate: The role of classroom management and exclusionary discipline strategies. *Journal of school psychology*. 2013 Oct 1;51(5):599–610.
18. Rathvon N. *Effective school interventions: Evidence-based strategies for improving student outcomes*. Guilford Press; 2008 Aug. p. 14.
19. Simonsen B, Fairbanks S, Briesch A, Myers D, Sugai G. Evidence-based practices in classroom management: Considerations for research to practice. *Educ Treat Child*. 2008 Aug;1:351–80.
20. Nagro SA, Fraser DW, Hooks SD. Lesson planning with engagement in mind: Proactive classroom management strategies for curriculum instruction. *Intervention in School and Clinic*. 2019 Jan;54(3):131–40.
21. Cook CR, Fiat A, Larson M, Daikos C, Slemrod T, Holland EA, Thayer AJ, Renshaw T. Positive greetings at the door: Evaluation of a low-cost, high-yield proactive classroom management strategy. *J Posit Behav Interventions*. 2018 Jul;20(3):149–59.
22. Rodwell L, Romaniuk H, Nilsen W, Carlin JB, Lee KJ, Patton GC. Adolescent mental health and behavioural predictors of being NEET: a prospective study of young adults not in employment, education, or training. *Psychol Med*. 2018 Apr;48(5):861–71.
23. Brownson RC, Eyler AA, Harris JK, Moore JB, Tabak RG. Research full report: getting the word out: new approaches for disseminating public health science. *J public health Manage Pract*. 2018 Mar;24(2):102.
24. Robertson RE, Buonomo K, Abdellatif H, DeMaria S. Results of a "Psychologically Wise" professional development to increase teacher use of proactive behavior management strategies. *Psychology in*

- the Schools. 2021 Apr 15.
25. Dusenbury L, Brannigan R, Hansen WB, Walsh J, Falco M. Quality of implementation: developing measures crucial to understanding the diffusion of preventive interventions. *Health education research*. 2005 Jun 1;20(3):308 – 13.
 26. Dickie J, Shuker MJ. Ben 10, superheroes and princesses: primary teachers' views of popular culture and school literacy. *Literacy*. 2014 Apr;48(1):32–8.
 27. Abry T, Rimm-Kaufman SE, Larsen RA, Brewer AJ. The influence of fidelity of implementation on teacher–student interaction quality in the context of a randomized controlled trial of the Responsive Classroom approach. *Journal of School Psychology*. 2013 Aug 1;51(4):437 – 53.
 28. Kincaid D, Childs K, Blase KA, Wallace F. Identifying barriers and facilitators in implementing schoolwide positive behavior support. *J Posit Behav Interventions*. 2007 Jul;9(3):174–84.
 29. Low S, Smolkowski K, Cook C. What constitutes high-quality implementation of SEL programs? A latent class analysis of Second Step® implementation. *Prev Sci*. 2016 Nov;17(8):981–91.
 30. Lyon AR, Bruns EJ. From evidence to impact: Joining our best school mental health practices with our best implementation strategies. *School Mental Health*. 2019 Mar;11(1):106–14.
 31. Cook CR, Lyon AR, Locke J, Waltz T, Powell BJ. Adapting a compilation of implementation strategies to advance school-based implementation research and practice. *Prev Sci*. 2019 Aug;20(6):914–35.
 32. Steinmetz H, Knappstein M, Ajzen I, Schmidt P, Kabst R. How effective are behavior change interventions based on the theory of planned behavior?. *Zeitschrift für Psychologie*. 2016 Oct 28.
 33. Cialdini RB, Goldstein NJ. Social influence: Compliance and conformity. *Annu. Rev. Psychol.*. 2004 Feb 4;55:591–621.
 34. Godin G, Kok G. The theory of planned behavior: a review of its applications to health-related behaviors. *Am J Health Promot*. 1996 Nov-Dec;11(2):87–98. doi: 10.4278/0890-1171-11.2.87. PMID: 10163601.
 35. Birken SA, Haines ER, Hwang S, Chambers DA, Bungler AC, Nilsen P. Advancing understanding and identifying strategies for sustaining evidence-based practices: a review of reviews. *Implement Sci*. 2020 Dec;15(1):1–3.
 36. Godin G, Bélanger-Gravel A, Eccles M, Grimshaw J. Healthcare professionals' intentions and behaviours: A systematic review of studies based on social cognitive theories. *Implement Sci*. 2008 Dec;3(1):1–2.
 37. Korteisto T, Kaila M, Komulainen J, Mäntyranta T, Rissanen P. Healthcare professionals' intentions to use clinical guidelines: a survey using the theory of planned behaviour. *Implement Sci*. 2010 Dec;5(1):1–0.
 38. Mangurian C, Niu GC, Schillinger D, Newcomer JW, Dilley J, Handley MA. Utilization of the Behavior Change Wheel framework to develop a model to improve cardiometabolic screening for people with severe mental illness. *Implement Sci*. 2017 Dec;12(1):1–6.

39. Fishman J, Yang C, Mandell D. Attitude theory and measurement in implementation science: a secondary review of empirical studies and opportunities for advancement. *Implement Sci.* 2021 Dec;16(1):1–0.
40. Fishman J, Beidas R, Reisinger E, Mandell DS. The utility of measuring intentions to use best practices: a longitudinal study among teachers supporting students with autism. *J Sch Health.* 2018 May;88(5):388–95.
41. Yeager DS, Dweck CS. Mindsets that promote resilience: When students believe that personal characteristics can be developed. *Educational psychologist.* 2012 Oct 1;47(4):302 – 14.
42. Blackwell LS, Trzesniewski KH, Dweck CS. Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Dev.* 2007 Jan;78(1):246–63.
43. Aronson J, Fried CB, Good C. Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of experimental social psychology.* 2002 Mar 1;38(2):113 – 25.
44. Walton GM, Cohen GL. A question of belonging: race, social fit, and achievement. *J Personal Soc Psychol.* 2007 Jan;92(1):82.
45. Cook CR, Frye M, Slemrod T, Lyon AR, Renshaw TL, Zhang Y. An integrated approach to universal prevention: Independent and combined effects of PBIS and SEL on youth's mental health. *School Psychol Q.* 2015 Jun;30(2):166.
46. Wood W. Attitude change: Persuasion and social influence. *Ann Rev Psychol.* 2000 Feb;51(1):539–70.
47. Cialdini RB. The science of persuasion. *Scientific American.* 2001 Feb 1;284(2):76–81.
48. Pratkanis AR. Social influence analysis: An index of tactics.
49. Spangenberg ER, Greenwald AG. Self-prophecy as a behavior modification technique in the United States. *The practice of social influence in multiple cultures.* 2001:51–62.
50. Filter KJ, Brown J. Validation of the PBIS-ACT full: An updated measure of staff commitment to implement SWPBIS. *Remedial and Special Education.* 2019 Feb;40(1):40–50.
51. Lewis CC, Klasnja P, Powell BJ, Lyon AR, Tuzzio L, Jones S, Walsh-Bailey C, Weiner B. From classification to causality: advancing understanding of mechanisms of change in implementation science. *Frontiers in public health.* 2018 May 7;6:136.
52. Kazdin AE. Mediators and mechanisms of change in psychotherapy research. *Annu. Rev. Clin. Psychol.* 2007 Apr 27;3:1–27.
53. Proctor EK, Powell BJ, McMillen JC. Implementation strategies: recommendations for specifying and reporting. *Implement Sci.* 2013 Dec;8(1):1–1.
54. Christofferson M, Sullivan AL. PRESERVICE TEACHERS' CLASSROOM MANAGEMENT TRAINING: A SURVEY OF SELF-REPORTED TRAINING EXPERIENCES, CONTENT COVERAGE, AND PREPAREDNESS. *Psychology in the Schools.* 2015 Mar;52(3):248–64.

55. Urbaniak GC, Plous S Research Randomizer (Version 4.0) [Computer software]. Retrieved on June 22, 2013, from <http://www.randomizer.org/>.
56. Moher D, Schulz KF, Altman DG. Consort Group. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials.
57. Larson M, Cook CR, Brewer SK, Pullmann MD, Hamlin C, Merle JL, Duong M, Gaias L, Sullivan M, Morrell N, Kulkarni T. Examining the effects of a brief, group-based motivational implementation strategy on mechanisms of teacher behavior change. *Prev Sci.* 2021 Aug;22(6):722–36.
58. Williams NJ. Assessing mental health clinicians' intentions to adopt evidence-based treatments: reliability and validity testing of the evidence-based treatment intentions scale. *Implement Sci.* 2015 Dec;11(1):1–3.
59. Sanetti LM, Kratochwill TR. Toward developing a science of treatment integrity: Introduction to the special series. *School Psychology Review.* 2009 Dec 1;38(4):445.
60. Chafouleas SM. Direct Behavior Rating: A review of the issues and research in its development. *Educ Treat Child.* 2011;34(4):575–91.
61. Wan F. Statistical analysis of two arm randomized pre-post designs with one post-treatment measurement. *BMC Med Res Methodol.* 2021 Dec;21(1):1–6.
62. Hayes AF, Cai L. Using heteroskedasticity-consistent standard error estimators in OLS regression: An introduction and software implementation. *Behav Res Methods.* 2007 Nov;39(4):709–22.
63. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J Roy Stat Soc: Ser B (Methodol).* 1995 Jan;57(1):289–300.
64. Wason JM, Robertson DS. Controlling type I error rates in multi-arm clinical trials: a case for the false discovery rate. *Pharm Stat.* 2021 Jan;20(1):109–16.
65. Faul F, Erdfelder E, Lang AG, Buchner A. G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods.* 2007 May;39(2):175–91.
66. Vandenberghe S, Vansteelandt S, Loeys T. Boosting the precision of mediation analyses of randomised experiments through covariate adjustment. *Statistics in medicine.* 2017 Mar 15;36(6):939–57.
67. Baron RM, Kenny DA. The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *J Personal Soc Psychol.* 1986 Dec;51(6):1173.
68. Hayes AF. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford publications; 2017. Dec 13.
69. Morris SB. Estimating effect sizes from pretest-posttest-control group designs. *Organizational research methods.* 2008 Apr;11(2):364–86.
70. IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.
71. MacKinnon DP, Krull JL, Lockwood CM. Equivalence of the mediation, confounding and suppression effect. *Prev Sci.* 2000 Dec;1(4):173–81.

72. Collier-Meek MA, Fallon LM, DeFouw ER. Toward feasible implementation support: E-mailed prompts to promote teachers' treatment integrity. *School Psychology Review*. 2017 Dec;46(4):379–94.
73. Kilbourne AM, Smith SN, Choi SY, Koschmann E, Liebrecht C, Rusch A, Abelson JL, Eisenberg D, Himle JA, Fitzgerald K, Almirall D. Adaptive School-based Implementation of CBT (ASIC): clustered-SMART for building an optimized adaptive implementation intervention to improve uptake of mental health interventions in schools. *Implement Sci*. 2018 Dec;13(1):1–5.
74. Eisman AB, Hutton DW, Prosser LA, Smith SN, Kilbourne AM. Cost-effectiveness of the Adaptive Implementation of Effective Programs Trial (ADEPT): approaches to adopting implementation strategies. *Implement Sci*. 2020 Dec;15(1):1–3.
75. Sohl SJ, Moyer A. Tailored interventions to promote mammography screening: a meta-analytic review. *Preventive medicine*. 2007 Oct 1;45(4):252 – 61.
76. Westerlund A, Nilsen P, Sundberg L. Implementation of implementation science knowledge: the research-practice gap paradox. *Worldviews on evidence-based nursing*. 2019 Oct;16(5):332.
77. Brownson RC, Colditz GA, Proctor EK, editors. *Dissemination and implementation research in health: translating science to practice*. 5: Oxford University Press; 2017 Dec.

Tables

Table 1

Descriptive Statistics of the Demographics (N =43)

Variables	Categories	N	%
Gender	Female	35	81.4
	Male	8	18.6
Grade level	Unknown	8	18.6
	1.00	7	16.3
	2.00	7	16.3
	3.00	7	16.3
	4.00	7	16.3
	5.00	7	16.3
Ethnicity	White	29	67.4
	Black	6	14.0
	Latino	5	11.6
	Asian	3	7.0
Teaching experience (years)	<= 5	17	39.5
	6 to 9	12	27.9
	> 10	14	32.6
Condition	Active control	21	48.8
	Treatment	22	51.2

Table 2

Independent Samples t-tests of Pretests of Variables between Treatment and Control Conditions

	Variables	<i>Mean</i>		<i>SD</i>		t-test for Equality of Means			Levene's Test for Equality of Variances	
		Ctrl	Trt	Ctrl	Trt	<i>t</i>	<i>df</i>	<i>p</i>	<i>F</i>	<i>p</i>
Process and Outcome Variables	Intentions to implement	20.57	20.23	5.69	5.50	-0.2	41	.84	0.01	.93
	Intervention fidelity	7.90	7.59	2.84	2.63	-0.38	41	.71	0.15	.70
	Academic engaged time	0.68	0.72	0.12	0.10	1.12	41	.27	0.21	.65
Teacher Demographics	Years of teaching experience	8.71	8.68	6.73	7.17	-0.02	41	.99	0.08	.78
	Grade	Pearson <i>Chi-Square</i>		<i>df</i>		Asymptotic Significance (2-sided)				
		2.98		5		.70				
	Ethnicity	0.55		3		.91				
	Gender	0.51		1		.48				

Note. Trt = Treatment Condition (P-PIES); Ctrl = Active Control Condition. SD = Standard deviation.

Table 3

Outcomes	Predictors	<i>b</i>	Beta	HC-SE	<i>t</i>	<i>p</i>	<i>q</i>	ES	Adj. <i>R</i> ²	<i>F</i> (<i>p</i>)
Intentions to Implement (ITI; post-test)	<i>Intercept</i>	7.52	-	1.95	3.85	.0005	.014*	-	.81	35.07 (<.001)
	Treatment	2.18	.23	0.65	3.34	.002	.021*	.40		
	ITI (pretest)	0.71	.83	0.07	9.84	<.0001	.007*	-		
	Experience	-0.13	-.19	0.05	-2.54	.016	.029*	-		
	Grade	0.04	.01	0.18	0.21	.836	.043	-		
	Ethnicity	-0.05	-.01	0.33	-0.14	.888	.05	-		
	Gender	-0.95	-.08	0.79	-1.2	.237	.036	-		
PCBM fidelity (post-test)	<i>Intercept</i>	3.78	-	0.97	3.9	<.001	.021*	-	.67	24.01 (<.001)
	Treatment	2.39	.43	0.53	4.51	<.001	.014*	.91		
	PCBM fidelity (pretest)	0.71	.69	0.09	7.77	<.001	.007*	-		
	Experience	-0.07	-.17	0.05	-1.44	.158	.029	-		
	Grade	-0.01	-.01	0.14	-0.1	.924	.05	-		
	Ethnicity	-0.11	-.04	0.32	-0.35	.730	.036	-		
	Gender	-0.18	-.03	0.8	-0.22	.824	.043	-		
Academic engaged time (AET; post-test)	<i>Intercept</i>	0.24	-	0.07	3.48	.001	.014*	-	.67	16.02 (<.001)
	Treatment	0.06	.28	0.02	3.03	.005	.021*	.47		
	AET (pretest)	0.69	.66	0.1	6.69	<.001	.007*	-		
	Experience	-0.002	-.15	0	-1.11	.274	.029	-		
	Grade	0.004	.06	0.01	0.5	.621	.043	-		
	Ethnicity	0.01	.08	0.01	0.77	.448	.036	-		
	Gender	-0.01	-.04	0.05	-0.25	.805	.05	-		

ANCOVAs Controlling for Pre-Test Values and Demographics as Covariates

Note. *q* = the FDR-corrected *p*-value for the corresponding hypothesis test for a variable. The * following a *q* value indicates that, for this test, the *p*-value is less than the *q*, which suggests a statistically significant

result after FDR adjustment. Treatment = study conditions (reference = the Attention Control Condition); b = unstandardized coefficients; Beta = standardized coefficients; HC-SE = heteroscedasticity-consistent standard error, "-" = Not Available, *Adj. R²* = adjusted R square.

Table 4

Configurations and Results of the Mediation Models

Model #	IV	M	DV	Direct Effect	Indirect/ Mediation Effect	95% CI of Mediation Effect	Total Effect	Mediation Type
1	Trt	ITI	Fid	1.207* (0.497)	1.036*	0.3769, 1.7904	2.242*** (0.61)	Partial Mediation
2	ITI	Fid	AET	-0.014*** (0.004)	0.019*	0.012, 0.027	0.005 (0.003)	Inconsistent Mediation

Note. $n = 43$; * $p < .05$; ** $p < .01$; *** $p < .001$. IV= predictor, M = mediator, DV = outcome; ITI = change score of teachers' intentions to implement EBPs. Fid = change score of intervention fidelity of PCBM. Trt = treatment vs control conditions. Statistics in the parentheses are standard errors. A mediation effect is considered significant if its 95% confidence interval based on 5,000 bias corrected bootstraps (CI; two tailed) does not include 0. Three decimals are reported to enhance precision.

Figures

CONSORT 2010 Flow Diagram

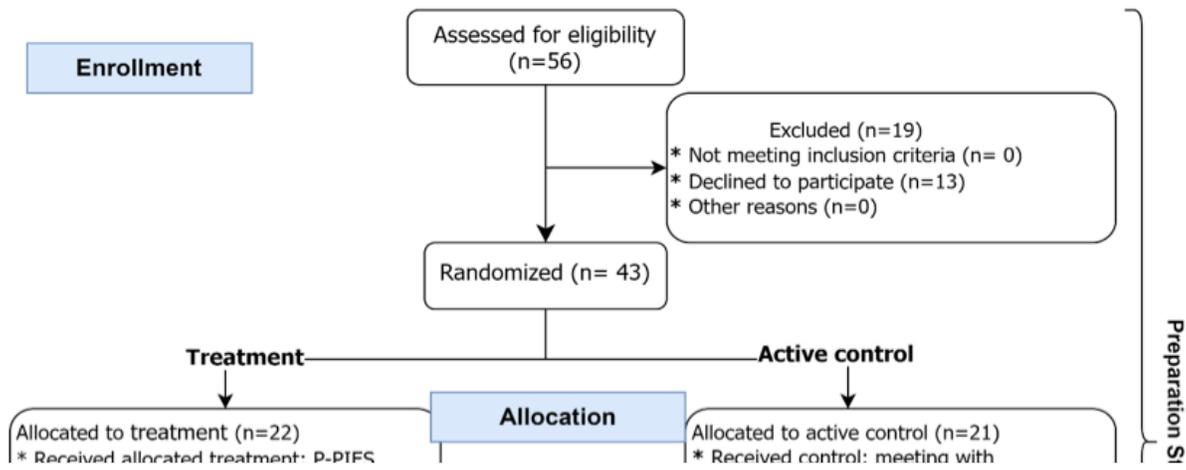
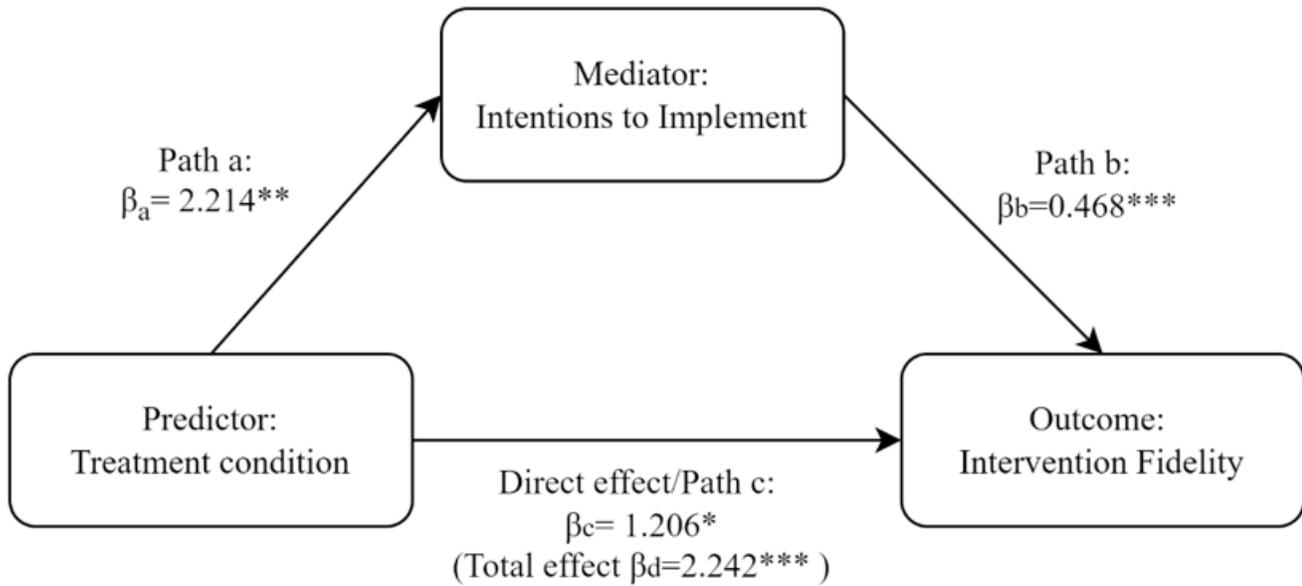
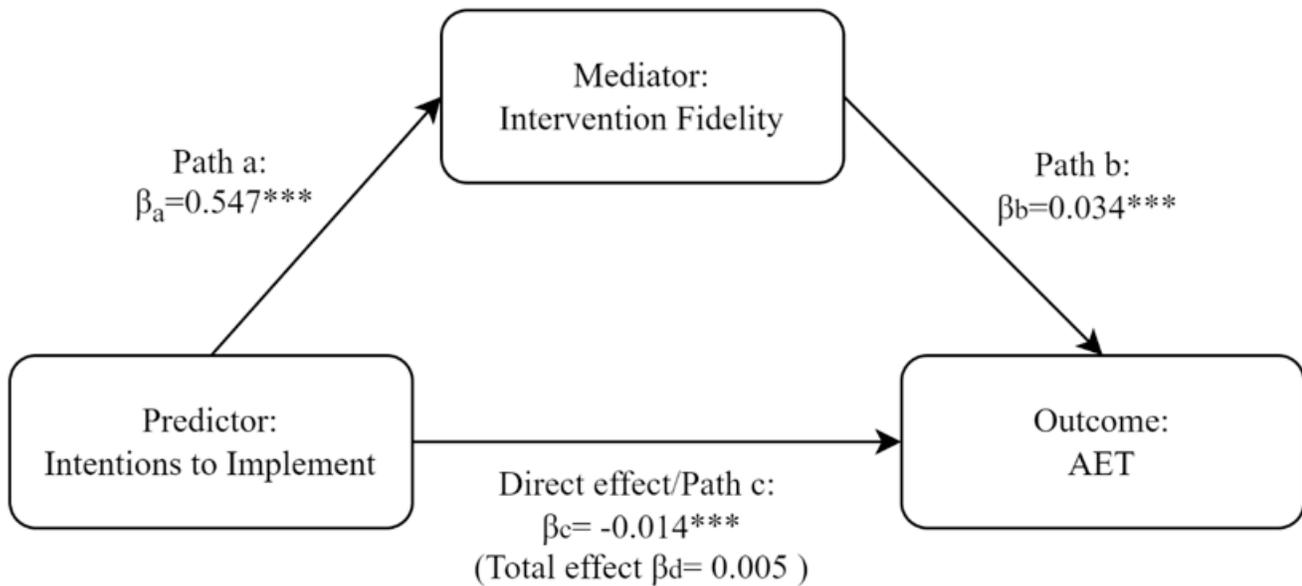


Figure 1

The CONSORT diagram delineates the study design timeline of treatment (P-PIES), assessment, and training, consultation, as well as pre-/post-/follow-up tests and variables assessed at each time point. ITI= teachers' intention to implement; FI = intervention fidelity, AET = class-wide youth academic engaged time. The brackets on the right indicate specific implementation stages that correspond to each step in this study.



(A)



(B)

Figure 2

* $p < .05$ ** $p < .01$, *** $p < .001$. $N = 43$. *Intentions to implement*, *intervention fidelity* and *AET* are change scores calculated by subtracting pretest score from posttest to account for baseline status. AET = academic engaged time. All beta weights are based on 5,000 bias corrected bootstrap estimations. β_a = the beta weight of the Predictor regressing on the Mediator, β_b is the beta weight for the Mediator

regressing on the Outcome. β_c is the beta weight for the Predictor when the Mediator is controlled (direct effect), while β_d is the beta weight for the Predictor when the Mediator is not controlled (total effect).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Additionalfile1PCBMstrategies.docx](#)
- [Additionalfile2CONSORT2010ChecklistPIES.doc](#)
- [Additionalfile3StaRlchecklistPIES.docx](#)