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Do teacher beliefs mediate the relationship between professional development and reading outcomes of students with emotional and behavioral disorders? An exploration of effects from a randomized controlled trial

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Abstract
Teachers of students with emotional and behavioral disorders face unique challenges in the classroom that are often not addressed in teacher preparation, which may result in diminished outcomes for teachers and students. The Integrated Literacy Study Groups professional development was designed to support the needs of teachers of students with or at-risk for emotional and behavioral disorders by integrating components of social-emotional learning and literacy instruction. The present study uses structural equation modeling to evaluate how and to what extent teacher beliefs, targeted in training through collaborative work groups and coaching experiences, mediate the relationship between the Integrated Literacy Study Groups and student reading achievement. Among a sample of 74 elementary school teachers, we found a directional relationship such that training influenced (1) beliefs pertaining to action, (2) beliefs pertaining to self, and (3) student reading outcomes. Beliefs pertaining to self was a significantly stronger mediator of the relationship between professional development and student reading outcomes. We discuss potential reasons for these findings as well as their implications for the design of training of teachers of students with or at-risk for emotional and behavioral disorders.

Keywords Teacher beliefs · Teacher training · Emotional-behavioral disorders

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1 Introduction

Students with emotional and behavioral disorders (EBD) face intense challenges throughout their education and lives. Most students with EBD have significant reading difficulties in addition to their behavioral challenges, yet reading intervention for students with EBD remains understudied (Garwood, 2018; Hollo et al., 2014). In fact, recent longitudinal investigations show that students with EBD display the slowest growth trajectories in reading compared to other disabilities (Yakimowski et al., 2016). It has also been found that students with EBD have lower academic achievement, fail more classes, and fail high stakes testing more often than students with other disabilities (Freeman et al., 2019; Landrum et al., 2003). Compared to other disability categories, students with EBD are also the most likely to drop out of school (Freeman et al., 2019; Kataoka et al., 2009), and subsequently have the highest rate of involvement with the criminal justice system (i.e., 75%; Newman et al., 2011). Students with EBD are in clear need of reading interventions tailored and sensitive to their specific needs that transcend interventions and therapies focused solely on behavioral and emotional outcomes (Garwood, 2018; Sanders et al., 2021).

Despite the clear needs of students with EBD, educators report that they receive limited in-service professional development to improve instructional practices geared towards their students' unique needs (Bradley et al., 2008). As a result, educators of students with EBD struggle to incorporate evidence-based instructional practices geared towards the needs of their students into their everyday routines (Gable et al., 2012; Lemons, et al., 2016; Levy & Vaughn, 2002; Vaughn et al., 2002). When teachers do receive professional development, the extent to which teachers believe that an educational initiative will impact outcomes affects the extent to which teachers will engage in that initiative (Boardman et al., 2005; Guskey, 1989; Liou et al., 2019). These beliefs may be particularly important for teachers of students with EBD for two reasons. First, beliefs surrounding the efficacy of instructional practices are impacted by student behaviors – that is, teachers provide more direct, evidence-based instruction to students who exhibit appropriate classroom behavior (Carr et al., 1991; Sutherland & Oswald, 2005) compared to students exhibiting misbehaviors (Emmer & Stough, 2001; Sutton, 2004). Second, while higher self-efficacy (i.e., teacher beliefs in their own abilities; Bandura, 1997) is related to higher instructional quality (Holzberger et al., 2013), teachers who experience misbehaviors are more likely to doubt their own self-efficacy (Lambert et al., 2009; Zee & Koomen, 2016) thus further reducing their instructional practices. Teachers' beliefs shape their instructional practices (Bates et al., 2011; Buehl & Beck, 2015; Fives & Buehl, 2016) and subsequent student outcomes (Zee & Koomen, 2016). Moreover, teacher beliefs (i.e., belief in efficacy of instruction; self-efficacy beliefs) are impacted due to challenging behaviors. It is therefore vital to ensure that teachers of students with EBD receive training that centers these beliefs within the training content.

1.1 The current study

Teachers have a direct and substantial impact on the outcomes of their students (Brownell et al., 2012). To improve student outcomes, training must be provided to teachers (Desimone, 2009); indeed, meta-analyses confirm that training of teachers significantly improves student outcomes (Blank & de las Alas, 2009; Didion et al., 2020; Yoon et al., 2007). Teacher beliefs about the value of and their capacity for content covered in an intervention influences their uptake of professional development (Boardman et al., 2005). However, it has not been demonstrated how teachers' beliefs targeted in training mediate student response. The present study evaluates the mediating effects of teacher beliefs on student outcomes within the context of a randomized controlled trial that evaluated the effects of a professional development training geared towards teachers of students with or at-risk for EBD.

1.1.1 Theoretical framework

The conceptual framework guiding this study is derived from Bandura's social cognitive theory of personal agency (Bandura, 2001) and Desimone's theory of teacher change (2009). According to Bandura's social cognitive theory of personal agency (2001), there are four components of personal agency: (a) intention, or a commitment to bringing about a course of action; (b) forethought, or attaching goals and perceived outcomes to this initial intention; (c) self-reactiveness, or regulation of the execution of these thoughts into action; and (d) self-reflectiveness, the evaluation of one's own abilities, values, and motivation. Self-efficacy is central to self-reflectiveness, and broadly refers to one's belief in their abilities to design and enact a plan of action that will result in their successful accomplishment of a situation or task (Bandura, 1997). The first three components (i.e., intention, forethought, and self-reactiveness) relate to the way in which *beliefs pertain to action*, while the latter component (i.e., self-reflectiveness) refers to the way in which *beliefs pertain to self*. Importantly, these constructs interact with each other in important ways. For example, self-reflectiveness may impact self-reactiveness (i.e., an individual with higher self-efficacy may also have more self-regulation). The opposite may also hold true; an individual with high self-regulation may also believe more in their own abilities.

Desimone (2009) posited that (1) training would improve teacher knowledge, skills, and beliefs; (2) improvement in each of these areas would improve teachers' instructional practices, and (3) student achievement would subsequently increase. Beliefs may be a central ingredient to teachers' implementation of newly learned skills in the classroom, as each of the components of personal agency influence the extent to which teachers will engage in a training as well as their subsequent outcomes (e.g., learning of training content, implementation of learned content in practice). For instance, a teacher with intentions to improve reading instruction of students with EBD will be motivated to take a related

course of action and may believe in their ability to improve the outcomes of students with EBD. As such, teacher beliefs may be central to translating learning into practice, and subsequently improving student achievement. It is currently unknown the ways and extent to which different teacher beliefs (i.e., beliefs pertaining to action, beliefs pertaining to self) mediate the impact of professional development on student outcomes.

1.1.2 Teacher beliefs pertaining to action

Beliefs act as a filter through which teachers receive new information (Fives & Buehl, 2012). As such, it is important that training incorporate practices that are intended to shift these pre-existing beliefs. As previously specified, intention, forethought, and self-reactiveness are sequential steps related to the translation of beliefs into action. There are several ways in which training can be designed to change teacher beliefs and subsequent actions. Collaborative training presents an opportunity for teachers to hold a similar set of norms and values, which in turn creates an intention to engage in a new practice (Liou et al., 2019; Popadiuk & Choo, 2006). Modeling of new practices creates an opportunity to build teachers' values surrounding and subsequent learning of the new practice (Girardet, 2018). This supports teachers' intention to enact change, as well as forethought about how to implement the practices. Finally, ongoing support within the context of a community of practice also creates an environment in which the perceived importance of instructional practices can be shared, and practices may be implemented (Fives & Buehl, 2012; Girardet, 2018; Tam, 2015).

1.1.3 Teacher beliefs pertaining to self

Self-efficacy is central to the self-reflective component of personal agency. As self-efficacy directly impacts teacher behaviors and student outcomes, researchers have called for building of self-efficacy to be a central component of trainings (Bray-Clark & Bates, 2003; Tschannen-Moran & McMaster, 2009). There are several ways in which to target self-efficacy in teacher training, in particular through targeting enactive mastery and vicarious experience (Bray-Clark & Bates, 2003; Lumpe et al., 2012). When teachers are provided with meaningful practice opportunities to master learned content (i.e., enactive mastery), they are more likely to engage in the practice in the classroom (Bray-Clark & Bates, 2003; Darling-Hammond & Richardson, 2009; Desimone, 2009; Tschannen-Moran & McMaster, 2009). Likewise, when teachers are provided with opportunities to observe examples and non-examples of successful implementation, they are more likely to master the content and thus implement the training in the classroom (Bray-Clark & Bates, 2003; Lumpe et al., 2012). Collaborative training presents an opportunity for teachers to work in groups to master content and provide real-world implementation examples, thus improving enactive mastery and vicarious experience (Bray-Clark & Bates, 2003). Ongoing coaching that integrates mastery experiences also has been shown to be linked to increased self-efficacy of students (Tschannen-Moran & McMaster, 2009).

1.1.4 The integrated literacy study groups

The Integrated Literacy Study Groups (ILSG; Benner et al., 2022) professional development was delivered as part of a randomized controlled trial with teachers of students with or at-risk for EBD. The ILSG training incorporated each of the components of training related to beliefs and behavior rooted in personal agency theory, with a logic model based on Desimone's framework for professional development. Over 10 sessions, teachers were trained to integrate social-emotional learning and reading instruction geared towards students with or at-risk for EBD. The content of the training sessions was delivered asynchronously online. Then, teachers participated in enactive mastery and vicarious experience in two ways: first, they collaborated with each other through discussion boards and posted real-world examples of the learned content. Second, teachers had access to an ongoing coach to help them problem-solve for their real-world implementation of the learned content. In each of these ways, beliefs pertaining to action and self were central to the ILSG training.

2 Research questions and hypotheses

Students with EBD experience great challenges throughout their education that often lead to diminished life outcomes. Teachers of students with EBD face unique challenges in the classroom that influence their ability to help surmount the barriers their students face. As such, improving teacher beliefs through training is essential to improve the outcomes of their students. It is well known that teacher beliefs impact student outcomes; however, prior studies have not demonstrated how beliefs targeted in training may mediate student response to such training. Thus, we explored the following sequential research questions:

(1) What is the relationship among teacher beliefs pertaining to self, teacher beliefs pertaining to action, and student reading achievement outcomes?

To evaluate the potential mechanisms for change in student outcomes as a result of training, we first tested competing models utilizing the pre-intervention phase data to determine the nature of the relationship among teacher beliefs pertaining to self, teacher beliefs pertaining to action, and student reading outcomes. Because teacher beliefs as a mechanism for teacher change as indicated by student outcomes in general are understudied, we considered this part of our purpose of the current study to be exploratory and did not hypothesize a direction to the relationship. After establishing the best fitting model, we then examined the degree to which beliefs mediated the effect of professional development on student reading outcomes, which presents our second research question.

(2) To what extent do teacher beliefs mediate the effects of professional development intervention on the reading outcomes of students with or at-risk for emotional and behavioral disorders?

We used structural equation modeling to examine this relationship with treatment condition as a moderating variable. Moderating variables are typically tested using structural equation modeling techniques with an variable of interest statistically regressed onto a covariate (e.g., Hagger et al., 2018; Sardeshmukh & Vandenberg, 2017; Singh & Sharma, 2016). We hypothesized that both self-beliefs and action beliefs would equally mediate the effects of treatment on reading outcomes, such that increased teacher beliefs in action and self would both positively impact student reading achievement.

3 Method

3.1 Sample

3.1.1 Teachers

Teachers were randomly assigned to the intervention or waitlisted control condition. Seventy-four elementary school teachers completed the study, including 43 in the waitlisted control condition and 31 in the intervention condition across both time points. Teachers had an average of 12.3 years teaching experience ($SD = 8.1$; range 1 – 36). Teachers were primarily female ($n = 68$), followed by male ($n = 5$) and transgender ($n = 1$). Teachers identified as White ($n = 56$), Black ($n = 7$), Hispanic/Latinx ($n = 5$), Asian ($n = 3$), multiracial ($n = 3$), other ($n = 2$), and Native American ($n = 1$), with two opting out of response. The highest educational attainment of teachers was primarily graduate degrees ($n = 53$), followed by bachelor's degrees ($n = 19$) and associate's degrees ($n = 2$). Forty-one teachers were general educators, and 33 were special educators.

3.1.2 Students

Each participating teacher selected two students with or at-risk for EBD to participate in this study ($n = 148$). Teachers were provided with a list of externalizing behaviors and instructed to select students with the most evidence of these behaviors (e.g., not complying with teacher instructions; disturbing others; arguing; not following teacher or school rules; Walker et al., 2014). Approximately 29% ($n = 43$) identified as female, 69% ($n = 104$) identified as male, and less than 1% ($n = 1$) identified as transgender. The average age was 8.41 years ($SD = 1.80$), with a range of grades from kindergarten to fifth grade. Approximately 46% ($n = 69$) of students identified as White, 24% ($n = 36$) identified as Black, 3% ($n = 4$) identified as Asian, 2% ($n = 3$) identified as Native Hawaiian/Pacific Islander, and 16% ($n = 24$) identified as other. Approximately 22% ($n = 33$) of students were identified as being Hispanic or Latinx. English language learners comprised approximately 8% ($n = 12$) of the sample. Finally, approximately 45% ($n = 67$) of the students receive special education services under an Individual Education Plan (IEP), with 33 of these students (49%) served under the category of emotional disturbance.

Table 1 Descriptive statistics for control versus intervention conditions

	Control *M* (*SD*)	Intervention *M* (*SD*)
CBAM_T1 Total Scores	104.88 (42.04)	112.61 (33.24)
CBAM_T2 Total Scores	81.09 (53.96)	112.71 (32.80)
TSES_T1 Total Scores	7.23 (1.01)	7.33 (0.85)
TSES_T2 Total Scores	7.22 (1.10)	7.86 (0.72)
Reading_T1 Total Scores	4.11 (0.63)	3.90 (0.78)
Reading_T2 Total Scores	4.02 (0.73)	4.28 (0.41)

CBAM = Concerns-Based Adoption Model (i.e., teacher action beliefs); TSES = Teacher Self-Efficacy Scale (i.e., teacher self-beliefs); Reading = oral reading fluency and nonsense word fluency curriculum-based measurement sum score (i.e., student reading achievement); T1 = time 1; T2 = time 2

3.2 Procedures

The analyses in the present study are derived from a pre-post randomized controlled trial of the efficacy of ILSG teacher training. Teachers were randomly assigned to treatment or waitlist control conditions after completion of a pre-test. All teachers were asked to identify two students with or at-risk for EBD, and assess their students using curriculum-based measurement (CBM). Then, teachers in the treatment condition completed 10 modules within 12-weeks in an online format in randomly assigned groups of 4 to 5 teachers. Each week a module was released, and it was anticipated to take an average of 90 min to complete the activities. After the training, all teachers completed the post-test battery, including post-tests of their selected students. Table 1 provides the descriptive statistics for study outcomes.

3.2.1 Training

The topics included in ILSG focused on the integration of reading and behavior strategies. Reading content was drawn from *Enhanced Core Reading Instruction* (ECRI; Fien et al., 2015; Smith et al., 2016) and behavioral content was drawn from evidence-based SEL and behavioral "kernels." The integration of reading and behavior instructional activities are shown to improve reading outcomes of students with or at-risk for EBD (Fruth, 2014; Garwood et al., 2017; Sanders et al., 2018). The content featured teacher explanations, teacher modeling of the skill or strategy, and collaborative responses consistent with targeting of self-efficacy and behavioral changes through training (Bray-Clark & Bates, 2003). Specifically, the modules followed a systematic learning sequence: (a) introduction, (b) reflection question, (c) new content, (d) guided practice, (e) application activities, and (f) discussion questions. Teachers reflected and discussed the week's content using an online discussion forum. For Modules 2–7, participants recorded themselves practicing a selected routine with peers giving feedback online. During Modules 8 and 9, teachers prepared a lesson plan for use with their students instead of a practice video. As for study attrition, the intervention group (43 to 31 from pre to post, 27% attrition) had

more attrition than the control group (45 to 43 from pre to post, 2% attrition), which is understandable given the training requirements as noted above.

3.2.2 Measures

3.2.2.1 Teacher beliefs pertaining to action We used the Stages of Concern Questionnaire, a subtest of the Concerns-Based Adoption Model (CBAM; Hall & Hord, 2005) to assess the beliefs of teachers pertaining to acting on an initiative, program, or practice. Within the context of the current study, the practices in question were related to reading instruction of students with or at-risk for EBD. The Stages of Concern Questionnaire therefore identified teacher attitudes and beliefs regarding implementation of practices with students with or at-risk for EBD (Hollingshead, 2009). Internal consistency reliability alpha coefficients range from 0.64 to 0.83 for each of 7 progressive categorical stages of concern: (0) awareness stage (participants have little exposure or understanding of an initiative), (1) informational stage (participants' attention is on learning more about an initiative), (2) personal stage (participants have uncertainty about the personal demands of implementation), (3) management stage (participants consider the logistics involved in implementation of the initiative), (4) consequence stage (participants' attention is on the impact of the initiative on student achievement), (5) collaboration stage (participants engage in initiative implementation with others), and (6) refocusing stage (participants consider methods to enhance the effects of the initiative or implement further courses of action). Participants are rated on a Likert-style scale from 0 (least intense) to 7 (most intense) in each of the categories. Intensity refers to the extent to which a teacher is focused on a particular stage. For example, a participant who has high scores (peaks) in both the consequence and collaboration stage may be more inclined to implement the intervention (Hall & Hord, 2005; Hollingshead, 2009). These categories relate to intention, forethought, and self-reactiveness components of Bandura's social cognitive theory of personal agency (2001). That is, intention is related to the awareness and informational stages; forethought is linked to the personal and management stages; and self-reactiveness is related to the consequence, collaboration, and refocusing stages. For the purpose of the current study, we created a multi-peak profile by summing scores for the seven stages (Yan & Deng, 2019). The multi-peak profile of the CBAM is a sum of the stage scores. In this case, a higher sum score indicates participants who demonstrated more intense consideration of the intervention across the stages (i.e., increased beliefs pertaining to action; George et al., 2013). Table 2 provides the means and standard deviations by stage for pre- and post-intervention. For more detailed information on the individual items and interpretation, see Yan and Deng (2019) and Hollingshead (2009), respectively.

3.2.2.2 Teacher beliefs pertaining to self Teacher beliefs pertaining to self was included as a composite of three measures. The *Teacher Sense of Efficacy Scale* (*TSES*; Tschannen-Moran & Hoy, 2001) is a 24-item Likert scale developed for educators to assess their own efficacy in three areas of teaching: (a) classroom management, (b) instructional practices, and (c) student engagement. This instrument has shown strong internal reliability ($\alpha = 0.90$) and construct validity (Tschannen-Moran & Hoy, 2001). For the

Table 2 Descriptive statistics for stage scores

Pre-Intervention	Control		Treatment	
	Mean	Standard deviation	Mean	Standard deviation
Stage 0: Awareness	8.88	6.33	12.55	4.80
Stage 1: Informational	19.70	8.19	20.13	6.59
Stage 2: Personal	19.93	8.33	19.74	5.76
Stage 3: Management	8.88	6.33	12.55	4.80
Stage 4: Consequence	15.19	7.64	15.94	7.35
Stage 5: Collaboration	19.16	9.13	20.03	6.99
Stage 6: Refocusing	10.63	6.27	11.77	6.57
Post-Intervention	Control		Treatment	
	Mean	Standard deviation	Mean	Standard deviation
Stage 0: Awareness	8.86	15.32	8.06	5.48
Stage 1: Informational	15.72	16.97	10.40	5.78
Stage 2: Personal	14.35	14.52	9.92	7.69
Stage 3: Management	8.86	15.32	8.06	5.48
Stage 4: Consequence	10.72	15.97	8.75	5.86
Stage 5: Collaboration	12.95	21.39	10.70	6.94
Stage 6: Refocusing	9.35	16.32	8.02	5.40

Participants were rated on a scale from least to most intense in each of the categories of the Stages of Concern on the Concerns-Based Adoption Model

purposes of the current study, we utilized the TSES scale score, a composite of the three subscales. Self-efficacy is associated with Bandura's construct of self-reflectiveness.

3.2.2.3 Student reading performance Student reading performance was measured immediately before and after the 12-week training using Dynamic Indicators of Basic Early Literacy Skills (8^{th} edition) nonsense word fluency (NWF) and oral reading fluency (ORF) curriculum-based measurement (CBM) on students' grade level (Dewey et al., 2015). The NWF CBM measure is a standardized, individually administered test of the alphabetic principle, while the ORF CBM measures accuracy and fluency with connected text. Test–retest reliability for elementary students ranges from 0.92 to 0.97; alternate-form reliability of different reading passages drawn from the same grade level range from 0.89 to 0.9. A composite score summing these constructs was utilized to assess reading.

3.3 Data analysis

Structural equation modeling techniques were applied in order to examine mediating and moderating variables using M*plus* (*v.* 8.0; Muthen & Muthen, 2018). Model fit

was evaluated via a combination of statistics including: the chi-square (χ^2) statistic; the Comparative Fit Index (CFI); the Tucker Lewis Index (TLI); the Root Mean Square Error of Approximation (RMSEA); and the Standardized Root Mean Square Residual (SRMR). Statistically non-significant chi-square statistic values are indicative of acceptable model fit, yet the chi-square statistic has been indicated to be sensitive to sample size and model complexity. CFI and TLI values at or greater than 0.90 indicate acceptable model fit (Little, 2013), as well as RMSEA values at or less than 0.08 (Little, 2013). SRMR values at or less than 0.10 (Little, 2013) also indicate acceptable fit. As models were nested, we also provided Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) values, where lower values indicate better fit (West et al., 2012). Direct and indirect effects were estimated as standardized coefficients with statistical significance evaluated at the 0.05 level or less. Direct and indirect effects summed together represent the total effect. The percent mediated is calculated as the indirect effect value divided by the total effect.

4 Results

To explore whether teacher beliefs (i.e., beliefs pertaining to action and beliefs pertaining to self) mediated the relationship between professional development and student reading achievement, we first compared competing models to determine the relationship between teacher beliefs and reading outcomes (e.g., Models A, B, and C; see Table 3). Model A estimated no directionality with bidirectional paths among teacher beliefs pertaining to action (CBAM), teacher beliefs pertaining to self (TSES), and student reading scores. Model B estimated TSES as mediating the relationship between CBAM and student reading achievement (i.e., CBAM TSES Reading). Model C estimated CBAM as mediating the relationship between TSES and reading achievement (i.e., TSES CBAM Reading). Model B was the best-fitting model when evaluating fit statistics. Table 3 also provides the degree of parameter recovery for each estimate. Coverage for parameter recovery values ranged from approximately 0.93 to 0.96 indicating that across 1000 replications, 94% to 96% of the time the parameter estimate was recovered. Generally, statistical power at above 80% is considered acceptable. An RMSEA-based calculation of statistical power of 1-β = 0.69 may be considered an overall value for the model.

We next evaluated individual path values for the best fitting model (i.e., Model B). First, the treatment condition was significantly associated with subsequent student reading scores, β = 0.08, $p = .02$ even after statistically controlling for prior reading achievement, β = 0.38, $p < .001$. The treatment condition was also significantly associated with subsequent teacher beliefs pertaining to self (β = 0.26, $p < .001$) even after statistically controlling prior self-efficacy scores (β = 0.59, $p < .001$). Teacher action beliefs (CBAM) were significantly related to teacher self- beliefs, β = 0.06, $p < .01$. Teacher self-beliefs were significantly related to student reading achievement, β = 0.45, $p < .001$. Teacher action beliefs were significantly related to student reading achievement, β = 0.22, $p < .05$. Approximately 33% of the relationship between teacher action beliefs and student reading achievement were mediated by teacher self-beliefs with an indirect effect of β = 0.11, $p < .001$. Figure 1 displays

Table 3 Competing Model Results

Model A: CBAM Beliefs correlated with Teacher Self-efficacy Scores (TSES)

Path	β	Parameter Recovery Coverage
CBAM WITH READ	0.19*	0.96
TSES WITH READ	0.49***	0.94
CBAM WITH TSES	0.33***	0.94

Model Results

$\chi^2(3) = 12.20$, $p = 0.007$

Comparative Fit Index = 0.85; Tucker Lewis Index = 0.71

Root Mean Square Error of Approximation (RMSEA) = 0.14

RMSEA-based Power = 0.69

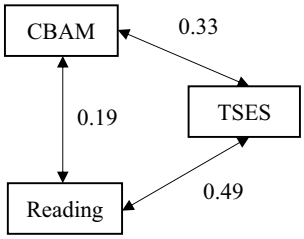
Standardized Root Mean Square Residual = 0.06

Akaike Information Criterion (AIC) = 2,974.23

Bayesian Information Criterion (BIC) = 3,007.19

Sample-Size adjusted BIC = 2,972.38

Distinguishing Model Paths



Model B: Teacher self-efficacy beliefs mediating the relationship between CBAM and reading

Path	β	Parameter Recovery Coverage
READ ON CBAM	0.04*	0.95
READ ON TSES	0.47***	0.94
TSES ON CBAM	0.33**	0.94

Model Results

$\chi^2(3) = 12.20$, $p = 0.007$

Comparative Fit Index = 0.85; Tucker Lewis Index = 0.71

Root Mean Square Error of Approximation (RMSEA) = 0.14

RMSEA-based Power = 0.69

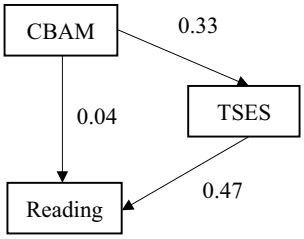
Standardized Root Mean Square Residual = 0.07

Akaike Information Criterion (AIC) = 1,469.35

Bayesian Information Criterion (BIC) = 1,496.32

Sample-Size adjusted BIC = 1,467.84

Distinguishing Model Paths



Model C: CBAM beliefs mediating the relationship between TSES and reading

Path	β	Parameter Recovery Coverage
READ ON CBAM	0.04*	0.94
READ ON TSES	0.39***	0.94
CBAM ON TSES	0.47**	0.95

Model Results

$\chi^2(3) = 12.20$, $p = 0.007$

Comparative Fit Index = 0.85; Tucker Lewis Index = 0.71

Root Mean Square Error of Approximation (RMSEA) = 0.14

RMSEA-based Power = 0.69

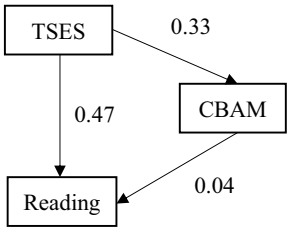
Standardized Root Mean Square Residual = 0.06

Akaike Information Criterion (AIC) = 2,567.67

Bayesian Information Criterion (BIC) = 2,594.65

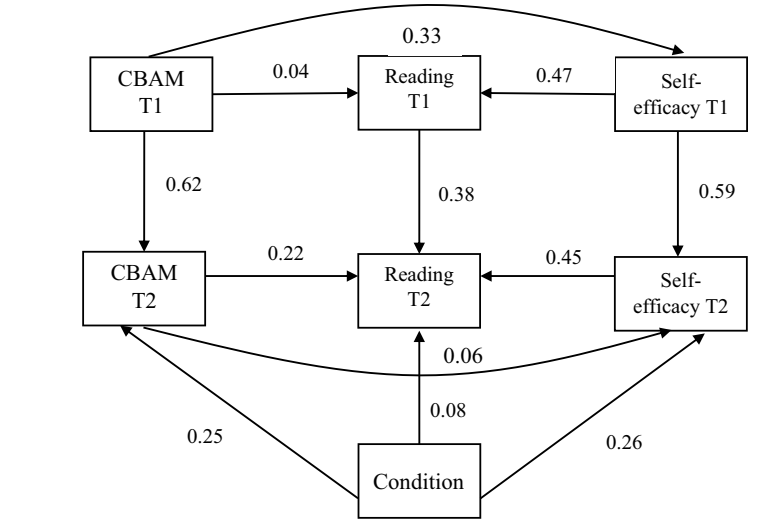
Sample-Size adjusted BIC = 2,566.16

Distinguishing Model Paths



the model tested along with standardized path coefficient values. We also statistically controlled for any initial differences between the randomly assigned conditions in teacher action beliefs, teacher self-beliefs, and student reading achievement (see Fig. 1).

We then tested the mediation of teacher action beliefs versus teacher self-beliefs in the relationship between intervention condition and student reading achievement. Approximately 61% of the relationship between intervention



Condition to Reading via CBAM beliefs	Condition to Reading via Teacher self-efficacy	CBAM to Reading via Teacher self-efficacy
Indirect Effect = 0.06	Indirect Effect = 0.13	Indirect Effect = 0.11
Direct Effect = 0.08	Direct Effect = 0.08	Direct Effect = 0.22
Total Effect = 0.14	Total Effect = 0.21	Total Effect = 0.33
43% mediated	61% mediated	33% mediated

Paths statistically controlled for initial differences in condition

Path	β
Condition WITH CBAM T1	0.10
Condition WITH Reading T1	0.20
Condition WITH Self-Efficacy T1	0.02

Fig. 1 Path diagram for best fitting model with indirect and direct effects. CBAM = Concerns-Based Adoption Model (i.e., teacher action beliefs); Teacher self-efficacy = Teacher Self-Efficacy Scale (i.e., teacher self-beliefs); Reading = oral reading fluency and nonsense word fluency sum score (i.e., student reading achievement)

condition and student reading achievement was mediated by teacher self-beliefs with an indirect effect of $\beta = 0.13$, $p < .001$. Approximately 43% of the relationship between intervention condition and student reading achievement was mediated by teacher action beliefs with an indirect effect of $\beta = 0.06$, $p < .001$. We constrained both mediators to be equal, which resulted in significantly worse model fit ($\chi^2(6) = 32.93$, CFI = 0.89, TLI = 0.75, RMSEA = 0.17, SRMR = 0.07) than the freely estimated Model B results (see Table 3). This result indicates that the mediation of teacher action beliefs versus teacher self- beliefs was not statistically equivalent and that teacher self-beliefs were a significantly better mediator

of the relationship between intervention condition and student reading achievement scores.

5 Discussion

Teacher beliefs are central to their experiences with professional development and instructional practices. This is particularly important for teachers of students with or at-risk for EBD, who experience increased behavioral challenges that impact their beliefs. The ILSG professional development program was designed to target the beliefs of teachers of students with or at-risk for EBD. In the present study, we explored whether teacher beliefs mediated student achievement outcomes. Our first research question asked: What is the relationship among teacher beliefs pertaining to self, teacher beliefs pertaining to action, and student reading achievement outcomes? We found a best-fitting model such that beliefs pertaining to action influenced beliefs pertaining to self, which in turn influenced the reading achievement of students with or at-risk for EBD. Our second research question asked: To what extent do teacher beliefs mediate the effects of professional development intervention on the reading outcomes of students with or at-risk for emotional and behavioral disorders? We found that beliefs pertaining to self were a significantly better mediator of effects than beliefs pertaining to action. In the following sections, we explore potential reasons for these findings.

5.1 Action beliefs influence self-beliefs then subsequent student outcomes

The best-fitting model indicated that action beliefs influenced self-beliefs, which then influenced student reading achievement. The relationship between action beliefs and self-beliefs aligns with Bandura's (2001) social cognitive theory of personal agency – that is, intention (i.e., commitment to bringing about a course of action), forethought (i.e., attaching goals and perceived outcomes to this initial intention), and self-reactiveness (i.e., regulation of the execution of these thoughts into action) impact teacher self-reflectiveness (i.e., self-efficacy). This model has not previously been imbedded within a model of teacher training (i.e., Desimone, 2009). Our full path model (see Fig. 1) indicated that the training was significantly related to self-beliefs, action beliefs, and student outcomes. Thus, the present study may extend Desimone's model, such that training has influence on action beliefs, followed by self- beliefs, and ultimately improved student outcomes. Meta-analyses support that teacher training improves student outcomes (e.g., Blank & de las Alas, 2009; Didion et al., 2020; Yoon et al., 2007); however, prior research has not demonstrated the mechanisms through which this change occurs. The present study therefore begins to unwrap the complex components that lead to teacher change by illuminating the directional relationship between action beliefs and self- beliefs within the context of a training delivered to teachers of students with or at-risk for EBD.

5.2 Beliefs pertaining to self a stronger mediator than beliefs pertaining to action

Importantly, we also found that, when comparing self and action beliefs, self-beliefs was a significantly stronger mediator. Self-efficacy is central to self-reflectiveness, the component of personal agency wherein an individual evaluates their own abilities, values, and motivation (Bandura, 1997). Teacher self-efficacy has been considered to be influential on a number of student outcomes, including achievement, motivation, student self-efficacy, and behavior in the classroom (Tschannen-Moran & Hoy, 2001). The present study builds upon this knowledge in several ways. First, it offers additional evidence that teacher self-efficacy beliefs increase the reading achievement of students with or at-risk for EBD. Second, self-efficacy was explicitly targeted in the training through collaboration with peers, likewise supporting findings of prior research that training with opportunities for collaboration improves teacher self-efficacy (Tschannen-Moran & McMaster, 2009). Finally, the present study demonstrates the mediating effect of improved teacher self-efficacy beliefs on student achievement resulting from targeted training. Thus, findings indicate that training can successfully improve self-efficacy beliefs of teachers of students with or at-risk EBD, and in turn improve students' academic achievement. The nature of this relationship is quite important, as the time and resources for training are limited. Teachers of students with EBD have higher rates of burnout (Brunsting et al., 2014) and turnover (Gilmour & Wehby, 2020; Merrell & Walker, 2004). Students with EBD experience significant reading challenges (Garwood, 2018; Hollo et al., 2014) and diminished life outcomes (Merrell & Walker, 2004). The present training indicates that a mechanism for improved reading achievement of students with or at-risk for EBD is improved teacher self-efficacy as a result of training, much aligned with Desimone's model of teacher training (2009). Thus training, in particular training that incorporates evidence-based practices shown to support teacher self-efficacy, can help meet the substantial challenges faced by teachers of and students with or at-risk for EBD.

The finding that teacher action beliefs did not mediate results as strongly as teachers' beliefs pertaining to self was surprising. Prior literature has found that teacher beliefs are related to their instructional practices (Bates et al., 2011; Buehl & Beck, 2015; Fives & Buehl, 2016) and subsequent student outcomes (Zee & Koomen, 2016). It may be that teacher action beliefs are a challenge to mitigate for teachers of students with or at-risk for EBD due to the reciprocal relationship between instructional practices and behavior – that is, the extent to which teachers engage in evidence-based, high quality instructional practices is highly associated with their students' behaviors (Carr et al., 1991; Emmer & Stough, 2001; Sutherland & Oswald, 2005; Sutton, 2004). These beliefs about taking action to enact a reading initiative may therefore be less malleable for teachers of students with EBD because of the misbehavior they experience in the classroom.

Although action beliefs remained constant for teachers who participated in the training, it is noteworthy that the action beliefs of teachers in the comparison condition decreased. Namely, teachers in the comparison condition held less intense beliefs pertaining to action (i.e., the implementation of instruction for students

with or at-risk for EBD) over the course of the study. This aligns with prior findings pointing to decreased beliefs pertaining to action of teachers of students with EBD over the course of the school year (Bettini et al., 2020). It is therefore possible that the training did have some effect on teachers who received the training in that their beliefs did not decrease over the course of the year, yet this effect was not enough to strongly mediate the relationship between training and student outcomes. It may also be that the design of the training met teacher needs related to self-beliefs more-so than action beliefs. Collaboration and coaching were imbedded to support teacher action beliefs. Meta-analyses indicate that coaching improves teacher practices (*pooled ES = 0.49,* Kraft et al., 2018) and collaboration significantly moderates effects of training (Filderman et al., 2021). However, the enactive mastery and vicarious experiences that were central to the collaborative groups and important for building teacher self-efficacy beliefs (Bray-Clark & Bates, 2003) may have influenced teacher self-beliefs above and beyond teacher action beliefs.

5.3 Limitations and future directions

Due to the exploratory nature of the current study, there are several limitations that emerged. First, multiple competing models were tested but other, untested competing models could also have fit the data well (e.g., MacCallum, 2003; Mueller & Hancock, 2008; West et al., 2012). These potentially untested models are unknown as models tested were based upon the purpose of the current study, and our contemporary conceptual and theoretical understanding of the variables and their potential relationships. Future research may replicate the findings of this study exploring various theoretically driven models using pre-registered methodology to provide further evidence surrounding these complex relationships. There are several limitations and areas for future investigation related to the study measures. As relates to the CBAM, scores can and have been utilized in multiple ways. The use of a multi-peak profile as an aggregated score is one way of analyzing the data (Yan & Deng, 2019) but does not examine the individual stage data within the CBAM. However, the purpose of current study was not to examine the developmental process of intervention adoption but rather the end result via cumulative scores. Future research may examine the developmental process of intervention adoption as a potential explanation for the current study results. Additionally, the CBAM could have been administered at multiple timepoints throughout the study in order to understand how teachers' beliefs changed throughout the course of the professional development. As relates to measures not administered, we did not include a measure of teacher practice. Future research can therefore further explore the relationship between beliefs and teacher practices in order to even better understand the ways in which Desimone's (2009) framework can explain teacher training. As we did not measure teacher practice, there are also limitations in our understanding of what occurred in teachers' classrooms. Future research may include observations of study classrooms to better contextualize findings. There are also limitations related to the general measure of teacher self-efficacy. We chose this measure because it tapped into the constructs covered in the professional development; however, future researchers may consider

using context-specific self-efficacy scales. Finally, a limitation of the study related to measures is that students were not formally screened to confirm their at-risk status for EBD. Although students were nominated by teachers for having externalizing behaviors that put them at risk as aligned with research-based screening tools, future studies that include more emphasis on behavioral outcomes may include formal behavioral assessments to better understand the effects on this student population. Other limitations include that the intervention group (43 to 31 from pre to post, 27% attrition) had more attrition than the control group (45 to 43 from pre to post, 2% attrition). However, the intervention versus control groups did not vary on any key demographics such as sex, race, or years of teaching experience. Additionally, as students are often taught in small groups in the classroom context, future research could explore potential group effects on student reading outcomes. We should also note that one could examine many of these relationships using a typical ANOVA (Analysis of Variance) design; however, it would not incorporate the specified relationships as hierarchically structured. In ANOVA designs, a researcher could statistically control these variables as covariates, but this would not acknowledge the configuration of the specified relationships as can be observed in the path diagram. Finally, the indirect effect of condition on students' outcomes through CBAM and self-efficacy as multiple mediators could be examined. However, in the current study, participants were randomly assigned with the variable of condition. As a result, students in the treatment condition had better reading outcomes than students who were not in the treatment condition. While it may be to our advantage to present results in this way, it is better to statistically control for this variable.

5.4 Implications

The present investigation has implications for the professional learning of educators who serve students with or at-risk for EBD. Unfortunately, preservice and in-service professional learning tends not to be sufficient to equip teachers of students with EBD to meet the intensive needs of this population. The result is that the reading achievement gap between students with EBD and their counterparts tends to widen over time (Yakimowski et al., 2016). Improving outcomes for students with EBD requires educators equipped with knowledge, beliefs, and skills to deliver high-quality reading instruction that integrates behavioral supports (Durlak et al., 2011; Nelson et al., 2008; Raver et al., 2009). Rooted in best practices for adult learning and teacher professional learning, the ILSG holds promise as a digitally delivered professional learning innovation to fill this critical professional learning gap. ILSG lends a model for training of teachers of students with or at-risk for EBD in several ways.

First, when developing training for teachers of students with or at-risk for EBD, findings from the present study suggest that incorporating teacher beliefs is an important consideration. To target beliefs, the current study had teachers participate in enactive mastery and vicarious experience by collaborating through discussion boards, posting real-world examples of the learned content, and participating in ongoing coaching. The findings of the present study provide preliminary evidence

that targeting beliefs in teacher training also improves the outcomes of students with or at-risk for EBD. As beliefs pertaining to self was a more important mediator than beliefs pertaining to action, it may be that targeting teacher action beliefs is not a necessary challenge to undertake; rather, trainers may choose to focus on improving self-beliefs. In such a case, collaboration with enactive mastery and vicarious experiences may be central to impacting student outcomes through training of teachers of students with or at-risk for EBD.

Second, we highlight that personalized coaching is an evidence-based professional learning approach that improves self-efficacy, quality of implementation, teacher instruction, and student outcomes (Diamond & Powell, 2011; Kraft et al., 2018). As noted in the introduction, when teachers are provided with meaningful practice opportunities to master learned content (i.e., enactive mastery), they are more likely to engage in the practice in the classroom (Bray-Clark & Bates, 2003; Darling-Hammond & Richardson, 2009; Desimone, 2009; Tschannen-Moran & McMaster, 2009). Likewise, when teachers are provided with opportunities to observe examples and non-examples of successful implementation, they are more likely to master the content and thus implement the training in the classroom (Bray-Clark & Bates, 2003; Lumpe et al., 2012). In ILSG, peer and virtual coaches provide models and additional opportunities to practice. Peer and virtual coaches also provide individualized, ad hoc feedback rather than feedback of an evaluative nature, which is often the nature of teacher feedback received from school administrators. Thus, the ILSG offers a model of coaching that may support the needs of teachers of students with or at-risk for EBD.

6 Conclusion

Through the context of a training designed for and delivered to teachers of students with or at-risk for EBD, we sought to explore the complex relationship between training, teacher action beliefs, teacher self-beliefs, and student reading achievement. We found that teacher action beliefs influence self-beliefs, which in turn influence student achievement. This finding reveals that personal agency theory may be an important consideration to account for in designing teacher training to promote student reading achievement. However, we also found teacher self- beliefs to be a much better mediator of the effects of training on student achievement than action beliefs. This finding may indicate that *teachers don't have to believe in an intervention—just in themselves.* Understanding these complex mechanisms for teacher training is essential to begin to improve teacher practices, particularly for teachers of students with or at-risk for EBD.

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Data availability In the interest of open science, this dataset is publicly available at 10.6084/m9.figshare.19716124.

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