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The effect of a virtual standards-based training program on physical education teacher self-efficacy

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Abstract
There is a need for sound self-efficacy measures in education that are based on Social Cognitive Theory. Physical education benefits public health by addressing physical inactivity and obesity. The purpose of this study was to develop and test a standards-based training program and virtual blog on self-efficacy. Participants were 60 physical education teachers recruited from 16 school districts. Three self-efficacy scales were administered at the beginning of a workshop and after a six-week collaborative blog. The major finding is that the intervention enhanced self-efficacy to a much greater extent than the control group. The average experimental group effect size for ESBI was .97 compared to .19 for the control group. This work could help guide future professional development opportunities.

Keywords: Professional development, online blog, virtual space

1. Introduction
School physical education is a key strategy to increase physical activity during childhood and improves the chance of physically active lifestyles [1]. Thus, physical education is important to public health because it addresses physical inactivity and obesity. One characteristic of quality physical education is a well-articulated and meaningful curriculum based on standards [2]. The task of creating learning environments conducive to development of knowledge and skill rests on the talents and self-efficacy of teachers [3]. Studies have reported low self-efficacy in physical education teachers, but little is known about self-efficacy for standards based physical education or how to increase self-efficacy. Clearly, improving self-efficacy among physical educators and specifically addressing their efficacy for delivering quality physical education through a standards based curriculum has the potential to impact public health. Relatively little information is available regarding the self-efficacy of physical educators and how confident those teachers are in their ability to deliver a standards based curriculum.

Teaching efficacy refers to "the extent to which the teacher believes he or she has the capacity to affect student performance" [4] general education, teacher efficacy has been found to predict student achievement [5] student motivation [6] and students own sense of efficacy [7]. Further, teacher efficacy has been linked to enthusiasm for teaching [8] high confidence levels and positive attitudes, willingness to experiment with new methods [9], amount of effort and persistence demonstrated, commitment to teaching [10], levels of novelty in instruction [9] an orderly and positive school atmosphere, and greater classroom-based decision making [11]. Teachers with a strong sense of efficacy tend to exhibit greater levels of planning and organization [8].

Bandura [3] has stated there is a need for sound self-efficacy measures in education that are based on the theoretical underpinnings of Social Cognitive Theory. Unfortunately, research on teacher self-efficacy has been "plagued" by methodological and conceptual shortcomings [3]. Ross' [4] meta-analytic study, for example, found that virtually all 87 studies he examined viewed teacher efficacy as a generalized expectancy, contrary to the domain- and task-specific conceptualization of self-efficacy proposed by Bandura [13]. Additionally, self-efficacy has been inadequately assessed with one-item scales that have failed to achieve correspondence between the self-efficacy measure and the behavior of interest [3]. Definitions of teacher self-efficacy have also confounded self-efficacy with outcome expectations and locus of control [12] making it difficult to reach substantial conclusions in this area.

Social Cognitive Theory defines human behavior as a triadic, dynamic, and reciprocal interaction of personal factors, behavior, and the environment [13]. According to Bandura [3] individuals establish their efficacy beliefs by interpreting results from four sources: mastery experience, vicarious experience, social persuasion, and physiological state. The most influential of these four sources is *mastery experiences*. Successes build a robust belief in one's self-efficacy. After people become convinced they have what it takes to succeed, they persevere in the face of adversity and quickly rebound from setbacks.

The majority of self-efficacy research in physical education has focused on validation of instruments. Martin and Hodges-Kulinna [15] developed a physical education teacher's physical activity self-efficacy (PETPAS) scale that allows researchers to assess teacher's self-efficacy for teaching classes with high levels of physical activity but this scale neglects other aspects important to quality physical education. Chase, Lirgg and Sakelos [16] found that teachers with high efficacy provided more Academic Learning Time (ALT), specific reinforcement, general organization, specific informational feedback, and less general punishment than teachers with low teacher efficacy.

Teachers are key agents of change for educational reform because they are practical curriculum decision makers, innovative instructional practitioners, and teachers are responsible for the execution of new educational visions [17]. The implementation of the NASPE standards will not occur without teachers understanding, acceptance, and support of the standards. In order to help students achieve desired learning outcomes, the teacher's responsibility is to understand, buy into, embrace, experiment and integrate the standards into their daily teaching practices. However, there is evidence that some physical education programs offer a limited curriculum that is not based on standards [19]. In the search for solutions, physical education must place greater emphasis on relevant activities, include physical activities that are enjoyable, build self-efficacy, and connect the curriculum to the world outside of the gymnasium [19].

Personal commitment to the teaching profession is the catalyst for teachers to seek continuous improvement of content knowledge and pedagogical practices aligned with the standards [17]. Teachers who had less desire for professional involvement and did not participate in professional development activities were unaware of current teaching innovations advocated in the standards [18]. Unfortunately, professional development activities may not be provided or encouraged in physical education, or those that are offered may not seem relevant to the physical educator's work [20].

Legitimate collaborations are rare in general education and even rarer in physical education [21]. Physical education teachers traditionally avoid long term collaboration with colleagues, resist involvement in whole school decision making [22] and find it difficult to find time to plan lessons with their peers [23]. When working collaboratively with universities in the form of professional development, physical educators report that they are empowered and have opportunities to participate in shared leadership [24]. Bandura [3] recommends intensive on-site training with guided practice and corrective feedback to translate conceptual change into desired school practices. A growing interest exists in the latest generation of web-based collaboration [25]. Blogs may be useful teaching and learning tools because they provide a space for teachers to reflect and publish their thoughts and understandings. Blog technology has the capacity to "engage people in collaborative activity, knowledge sharing, reflection and debate, where complex and expensive technology has failed" [26]. Evidence shows that in-service science teacher efficacy scores could be increased through professional development emphasizing collaboration and inquiry learning, although no control group or effect sizes were reported [27]. A critical question is whether or not this will work in physical education.

Given this lack of research and the importance of physical education classes, the first purpose of this study was to test an intervention based on Bandura's social cognitive theory [13] to increase physical education teacher self-efficacy for standards based curricula. The second purpose was to examine the impact of virtual collaboration (via a blog) on self-efficacy.

2. Materials and Methods

2.1 Experimental Design

This was a pre-post design with experimental and control groups. Each group participated in a different face-to-face workshop with the same facilitator. The experimental group also received on-going support through an internet blog. The experimental and control workshop were equivalent in length, engagement and participant satisfaction even though the content was different.

2.2 Participants

A priori power analysis indicated a total of 42 teachers (experimental group N=21, control group N=21) were needed as participants, based upon an efficacy effect size of 0.8 (α=.05, β =.80). A total number of 60 teachers (experimental N= 35, control N=25) volunteered for the study. Post hoc power analysis indicated sufficient power for detecting differences in self-efficacy scores by group (α=.05, β =.79). Teachers represented 16 school districts that were paired based on enrollment, free and reduced price lunch eligibility, and race. Random assignment of experimental or control conditions were made at the district level (by pairing districts) to prevent contamination of experimental and control conditions. The face-to-face workshop and intervention was provided to individual teachers in virtual space through a password-protected weblog. Thus, teacher was the unit of analysis.

2.3 Measures

Teacher Efficacy Scale in Physical Education (TESPE). The Teacher Efficacy Scale in Physical Education (TESPE) [28]. was used to assess how confident each teacher feels that he or she can positively affect the learning of students. The TESPE consists of 16 items on four dimensions of teacher efficacy: motivation, analysis of skills, preparation, and communication.

Teachers' Sense of Efficacy Scale (TSES). To account for the currently unknown construct validity of the TESPE, a second measure of self-efficacy was used; the Teachers' Sense of Efficacy Scale (TSES-short form) [29]. The Teacher Sense of Efficacy Scale assesses a teacher's efficacy for instructional strategies, student engagement, and classroom management.

Efficacy for Standards-based Instruction (ESBI). Researchers created the third self-efficacy tool, the Efficacy for Standards-based Instruction (ESBI) scale to measure self-efficacy for curricular decisions (relative to NASPE standards) [30] of physical education teachers because this specific self-efficacy measurement does not exist (Figure 1). The ESBI consists of 20 items on four dimensions of physical education teacher efficacy; knowledge, planning, instruction, and assessment.

The ESBI was devised from the specific objectives for PECAT to rate physical educator's confidence in their ability to align district standards, benchmarks, lessons, and assessments and relate these to the national physical education standards. Following Bandura's (2006) guidelines, strength of teacher efficacy beliefs were recorded using a 100-point scale, ranging in 10-unit intervals from 0 ("*Cannot do*"); through intermediate degrees of assurance, 50 ("*Moderately certain to do*"); to complete assurance, 100 ("*Certain can do*").

Figure 1: The Efficacy for Standards-based Instruction (ESBI) scale

Efficacy for Standards-based Instruction (ESBI)

Directions: The attached form lists different teaching activities. In the column **Confidence,** rate how confident you are that you can do them **as of now**. Rate your degree of confidence by recording a number from 0 to 100 using the scale given below. Please be honest in your evaluation. Your answers are confidential.

0	10	20	30	40	50	60	70	80	90	100
Cannot do at all					Moderately certain can do					Certain can do

	Confidence (0-100)
Understanding the Curriculum in the District	
Can analyze the strengths and weaknesses of written curricula	_____
Understand the framework and content of my district's physical education curriculum	_____
Understand the standards and benchmarks used in my district's physical education curriculum	_____
Am able to determine how feasible and affordable it is for the school district and physical education teachers to implement the curriculum successfully	_____
Understand the overall goals or focus on the physical education curriculum in my district	_____
Planning Based on the Curriculum Model	
Can align objectives, content, practice, feedback, and assessments for my specific grade level(s)	_____
Collaborate with colleagues to develop a district curriculum that meets national standards	_____
Plan lessons that help students master the content	_____
Develop multiple lesson plans that address each benchmark so students have many opportunities to master the content	_____
Can align lesson plans and curriculum with current local, state, and/or national standards	_____
Teaching the Curriculum Model	
Base instruction on local, state and /or national physical education standards	_____
Clearly communicate instructional goals to students	_____
Provide content and tasks that are developmentally appropriate and properly sequenced	_____
Provide meaningful physical education content	_____
Provide instruction that facilitates student learning	_____
Assessment	
Continually assess student performance to guide instruction	_____
Base assessment on mastery of learning expectations which are outlined in district standards and benchmarks	_____
Can document student learning in physical education	_____
Use multiple assessment strategies to monitor student learning	_____
Modify lessons and/or instruction in response to information from assessment	_____

2.4 Validity and Reliability of Measures

Cronbach's alpha (internal consistency) for the ESBI was .96, and the Equal-Length Spearman Brown split-half coefficient inferred good reliability (r=.90). The ESBI demonstrated better validity and reliability than the previously developed TESPE (Cronbach's alpha = .89; Spearman Brown split-half coefficient=.86) and TSES (Cronbach's alpha=.84, Spearman Brown split-half coefficient=.79). As a test of concurrent validity for ESBI, Pearson's product moment correlations were performed to test the extent to which the total efficacy scores and subscales were related. The ESBI, TESPE, and TSES all had a significant positive correlations (r=.49 for ESBI and TESPE; r=.44 for ESBI and TSES; r=.58 for TESPE and TSES) with each other (p<.01). Discriminant validation of the three self-efficacy scales was identified using the ranked Physical Education Curriculum Analysis Tool (PECAT) score for each district as an independent measure (discriminant validity). The ESBI scale produced a low but

significant correlation (r=.28, p<.05) with PECAT but TSES and TESPE were not significant.

2.5 Procedure
All elementary, middle school, and high school physical education teachers within each cooperating district were invited to participate. The study was approved by the Institutional Review Board and all participants completed an informed consent. At the conclusion of each face-to-face meeting a mean satisfaction score from a 5-point scale was completed by teachers to evaluate how positively they viewed the training session. The three self-efficacy assessments were made at baseline and six weeks after face-to-face training.

2.6 Control condition
The control condition consisted of one face-to-face meeting in each of eight districts where the Healthy Kids Act (relatively new state legislation requiring schools to provide physical activity for students) was discussed (baseline). Six weeks later the teachers were asked to complete the self-efficacy measures a second time (endline).

2.7 Intervention condition
Physical education teachers in the intervention condition attended one face-to-face meeting with a focus on collaboration and vertical/horizontal alignment of standards and benchmarks. The intervention was designed to support the three components of Social Cognitive Theory (personal, behavioral, and environmental factors).

Personal factor intervention supports designed to increase participant self-efficacy included discussion of the National Association of Sport and Physical Education (NASPE) description of quality physical education and best practices and how participants have personally exhibited those teaching characteristics. *Behavioral factor* intervention supports were reinforced through physical educator self-monitoring, goal-setting guidance, and discussion of the parts of high quality physical education under their control through curricular decision making.

Environmental factor intervention support was provided by an introduction to the CDC's (2006) Physical Education Curriculum Analysis Tool (PECAT) [2]. Physical educators (K-12) received an assessment of their current district alignment using PECAT and assistance in developing horizontally and vertically aligned standards and benchmarks during a workshop. Further, environmental support was demonstrated through presentation of anecdotal evidence indicating some administrators are supportive of physical education despite difficult economic times and academic pressure [32].

The standards-based intervention developed for this study also targeted Bandura's (1986) framework of information and experiences that contribute to the development of self-efficacy beliefs: mastery experience, vicarious experience, verbal persuasion, and emotional arousal [13]. *Mastery experiences* were supported during the face-to-face meeting through a discussion of NASPE's description of quality physical education, best practices and how participants have personally exhibited those teaching characteristics. A discussion of how district physical educators have contributed to quality physical education in their school provided *vicarious experiences* to increase self-efficacy levels. Persuasive reassurances that the teacher possesses the capabilities to execute effective standards-based design strategies were also provided (*verbal persuasion*). Participants received reminders of their commitment to the profession by their attendance and participation in the current investigation. As advocated by Bandura (1986) the current intervention attempted to eliminate emotional reactions to subjective threats through the aforementioned mastery experiences and creating a relaxed and upbeat mood (*emotional arousal*). Eliminating such threats is believed to correspond with improvements in self-efficacy and skill [3].

Finally, physical educators were introduced to a collaborative model [27] aimed at developing the skills necessary to become effective K-12 collaborators. Thus, the meeting concluded with the introduction of an online blog that they were asked to use for communication with physical education teachers within their district as well as the researcher regarding the use of national standards and benchmarks for six weeks following the face-to-face meeting.

2.8 Six-week Intervention in Virtual Space
Each teacher was provided with a pre-arranged WordPress.com blog account. Access to each school district's blog was limited to teachers within that same district for discussion. Each week for six weeks, a different NASPE Content Standard was addressed. At the beginning of each week an email was sent to all participants with a link to the blog. Teachers were presented with benchmarks for each of the six standards to stimulate discussion each week. For example, during Week 3 the posting was *"Standard 3: Participates regularly in physical activity. Sample performance outcomes (across the K-2 grade range) include:*

- *Engages in a variety of locomotor activities (e.g., hopping, walking, jumping, galloping, and running) during leisure time*
- *Participates in chasing and fleeing activities outside of school*
- *Participates in a variety of nonstructured and minimally organized physical activities outside of physical education class (e.g., tag, hide-and-seek).*

Information on the intent of each standard was provided weekly via the blog with information cited from *Moving into the Future: National Standards for Physical Education* [30]. The same material was posted on each district's blog and the same emails were sent to all participants each week. Interaction among physical education teachers was encouraged within each district via blog and a reminder that stated "success is a result of effort (for teacher and student)".

2.9 Post-Baseline Data Collection
The three self-efficacy instruments administered at baseline (TSES, TESPE, and ESBI) were mailed to experimental and control teachers at their school address with a pre-paid postage return envelope for post-intervention data collection.

2.10 Statistical Analysis
Primary outcome variables were measures of three types of teacher self-efficacy (TSES, TESPE, and ESBI) at two time points (pre- and post). The primary hypothesis—teacher efficacy will be greater among intervention teachers compared to control teachers and baseline assessment—was tested with a self-efficacy measure (3) x group (2) x time (2) repeated measures MANOVA. Effect sizes were calculated to assess the practical meaningfulness of the intervention in condition to the control condition. Pearson-product moment correlations were used to examine the impact of virtual collaboration on self-efficacy. All computations were carried out with SPSS Version 17.0 (Chicago, IL).

3. Results

A total of 60 participants started the study and 48 completed the study (27 experimental, 21 control) for retention rates of 77% and 84%, respectively. Baseline self-efficacy levels for dropouts and full participants for the three measures of self-efficacy were compared. Effect sizes were small (ESBI=.43; TESPE=.21) with the distribution of upper and lower boundaries of the 95% confidence intervals for the drop-outs completely encompassing the full participants for ESBI (55.2-80.3 dropouts and 71.4-78.2 dropouts) and TESPE (dropouts 87.3-99.0 and completers 93.3-98.2). The TSES had the smallest effect size (.04) but the confidence intervals did not overlap (dropouts 76.9-88.5 and full participants 75.2-89.2; Table 1). Considering the small effect sizes and confidence intervals the dropouts did not appear to differ from the participants that completed the study for the key variables of interest. There were no significant differences (t (1) =2.13, p=.14) between full participants and dropouts in workshop satisfaction score (completer mean satisfaction = 1.42, SD = .54; dropout mean satisfaction = 1.17, SD = .40) based on independent t-tests and confidence intervals, although confidence intervals did not overlap. Based on baseline confidence intervals (p<.05), experimental and control groups were not significantly different in terms of teaching experience, education level or baseline self-efficacy levels (TSES, TESPE, and ESBI).

The dependent variables used in this analysis were deemed normally distributed after examining the skewness, kurtosis and Q-Q plots within each group (e.g., experimental and control) so parametric statistics were used. Descriptive data for the intervention and control groups at baseline and end point for the three measures of self-efficacy are presented in Table 1.

Table 1: Descriptive data for the self-efficacy measures by group and time. Overall effect of Standards-based training intervention on physical educator self-efficacy.

Control Group (n = 25) Experimental Group (n = 35)						
Scale	Baseline *M* (*SD*)	End *M* (*SD*)	ES	Baseline *M* (*SD*)	End *M* (*SD*)	ES
	(95% CI)	(95% CI)	(95% CI)	(95% CI)	(95% CI)	
ESBI	76.92 (10.88)	78.97 (9.95)	.19	70.83 (15.22)	84.31 (8.96)	.97
	(72.97-83.09)	(74.84-83.10)		(67.77-76.69)	(80.67-87.95)	
Assessment	18.12 (4.30)	18.66 (4.21)	13	17.11 (4.05)	20.93 (2.54)	1.13
	(17.60, 20.09)	(17.18, 20.14)		(15.61, 18.69)	(19.62, 22.23)	
Planning	19.94 (3.28)	19.75 (2.86)	.06	17.48 (4.36)	21.13 (2.65)	1.01
	(18.65, 21.79)	(18.55, 20.95)		(16.27, 19.04)	(20.07, 22.19)	
Instruction	20.01 (1.96)	20.41 (1.38)	.23	18.74 (4.31)	21.65 (1.59)	.89
	(19.11, 21.68)	(19.75, 21.07)		(18.05, 20.33)	(21.07, 22.23)	
Knowledge	18.85 (3.27)	20.11 (3.61)	.38	17.5 (4.34)	20.60 (2.88)	.87
	(17.60, 20.56)	(18.82, 21.51)		(16.94, 19.55)	(19.42, 21.79)	
TESPE	96.3 (10.7)	95.5 (7.5)	-.09	92.4 (5.3)	94.5 (6.6)	-.35
	(93.6, 100.9)	(92.7, 98.3)		(91.3, 97.8)	(89.9, 94.9)	
Skill	24.8 (2.6)	24.8 (1.9)	.00	23.9 (2.2)	22.9 (1.5)	-.53
	(24.3, 26.1)	(24.1, 25.5)		(22.9, 24.6)	(22.2, 23.5)	
Preparation	23.7 (3.5)	23.9 (3.2)	-.06	22.9 (2.5)	22.1 (2.8)	-.30
	(22.4, 25.2)	(22.6, 25.2)		(21.9, 24.3)	(20.9, 23.3)	
Comm.	24.3 (3.2)	23.5 (1.8)	.27	24.1 (2.2)	24.6 (1.1)	-.29
Motivation	23.5 (2.9)	23.3 (2.6)	-.11	23.6 (1.9)	23.2 (2.2)	-.20
	(22.5, 24.6)	(22.3, 24.3)		(22.6, 24.5)	(22.3, 24.1)	
TSES	83.3 (9.2)	83.3 (9.1)	.00	82.5 (10.2)	83.0 (4.0)	.06
	(80.7, 88.9)	(80.4, 86.2)		(78.8, 86.0)	(80.4, 85.6)	
Instruction	28.2 (4.6)	27.9 (3.5)	.07	27.8 (3.3)	28.9 (2.2)	-.39
	(27.3, 30.7)	(26.7, 29.2)		(26.4, 29.3)	(27.8, 29.0)	
Engagement	23.6 (5.0)	23.6 (5.3)	.00	24.9 (4.7)	24.4 (1.7)	.14
	(21.7, 25.8)	(21.9, 25.2)		(22.8, 26.4)	(23.0, 25.9)	
Management	31.5 (3.3)	31.8 (2.8)	.09	29.8 (4.4)	29.4 (3.2)	-.10
Skill	24.8 (2.6)	24.8 (1.9)	.00	23.9 (2.2)	22.9 (1.5)	-.53
	(24.3, 26.1)	(24.1, 25.5)		(22.9, 24.6)	(22.2, 23.5)	
Preparation	23.7 (3.5)	23.9 (3.2)	-.06	22.9 (2.5)	22.1 (2.8)	-.30
	(22.4, 25.2)	(22.6, 25.2)		(21.9, 24.3)	(20.9, 23.3)	
Comm.	24.3 (3.2)	23.5 (1.8)	.27	24.1 (2.2)	24.6 (1.1)	-.29
	(23.6, 25.8)	(22.8, 24.1)		(23.2, 25.1)	(23.9, 25.1)	
Motivation	23.5 (2.9)	23.3 (2.6)	-.11	23.6 (1.9)	23.2 (2.2)	-.20
	(22.5, 24.6)	(22.3, 24.3)		(22.6, 24.5)	(22.3, 24.1)	
TSES	83.3 (9.2)	83.3 (9.1)	.00	82.5 (10.2)	83.0 (4.0)	.06
	(80.7, 88.9)	(80.4, 86.2)		(78.8, 86.0)	(80.4, 85.6)	
Instruction	28.2 (4.6)	27.9 (3.5)	.07	27.8 (3.3)	28.9 (2.2)	-.39
	(27.3, 30.7)	(26.7, 29.2)		(26.4, 29.3)	(27.8, 29.0)	
Engagement	23.6 (5.0)	23.6 (5.3)	.00	24.9 (4.7)	24.4 (1.7)	.14
	(21.7, 25.8)	(21.9, 25.2)		(22.8, 26.4)	(23.0, 25.9)	
Management	31.5 (3.3)	31.8 (2.8)	.09	29.8 (4.4)	29.4 (3.2)	-.10
	(30.4, 33.8)	(30.5, 33.1)		(28.5, 31.5)	(28.2, 30.6)	

SD, Standard Deviation; CI, Confidence Interval; ES, Effect Size

3.1 Efficacy for Standards-based Instruction (ESBI)

The repeated measure MANOVA with ESBI as the dependent variable produced significant results for group [$F(1,46)=15.37$, $p=.001$], time [$F(1, 46)=13.46$, $p=.001$] and the group by time interaction [$F(1,46)=9.87$, $p=.003$]. The interaction of time (baseline and endpoint) and group (experimental and control) was the effect of primary interest. Follow-up ANOVAs indicated significant effects for all four ESBI subscales over the six-week period; understanding [$F(1,46)=12.23$ $p=.001$], planning [$F(1,46)=7.59$, $p=.008$], teaching [$F(1,46)=6.32$, $p=.016$] and assessment [$F(1,46)=17.27$, $p<.001$]. Baseline and endpoint ESBI self-efficacy scores were significantly different from each other for the experimental group but not significant for control group. The average effect size for experimental group was .97 compared to .19 for control condition participants (Table 1).

3.2 Teacher Efficacy Scale in Physical Education (TESPE)

The multivariate tests produced three non-significant results for group [F $(1,46)=2.13$, $p=.106$], time [$F(1, 46)=2.59$, $p=.11$] and the group by time interaction [$F(1,46)=.021$, $p=.89$]. As shown in Table 1, TESPE scores in this study remained essentially unchanged for experimental and control groups. Based on confidence intervals, baseline and endpoint TESPE self-efficacy scores were not significantly different nor did these meet the criteria to be declared the same.

3.3 Teachers' Self-Efficacy Scale (TSES)

The multivariate tests produced three non-significant results for group [$F(1,46)=0.03$, $p=.89$], time [$F(1, 46)=0.15$, $p=.70$] and the group by time interaction [$F(1,46)=0.79$, $p=.38$]. TSES self-efficacy did not change significantly during the six-week time period (Table 1). Based on the confidence intervals, TSES scores for the intervention group were declared the same, however the control group was neither the same or different based on the data.

3.4 Standards-based Training Debriefing Questionnaire.

At the end of the workshop, a debriefing questionnaire was completed by 60 teachers (25 control and 35 intervention teachers). Responses on the Likert-type questions (scored from 1 to 5, highest to lowest). Teachers were very satisfied with the face-to-face meeting with positive views (experimental $M = 1.43$, $SD = 0.55$; control $M = 1.32$, $SD = 0.48$). Independent t-tests ($t(2)=1.5$, $p=.86$) indicated no significant differences between how the intervention and control groups viewed the intervention.

3.5 Collaboration in Virtual Space (Online Blog).

All intervention participants were invited to participate in the collaborative weblog. Overall, 48.6% ($n = 17$) of intervention teachers posted at least one blog comment for a total of 22 comments. Teachers viewed their district blog more frequently than they participated in blog discussions (mean district blog views = 45.23 vs. mean district comments = 10.88). One district did not post any comments during six weeks. Teachers indicated the class activities used to meet NASPE standards during the six-week intervention period. Fitness testing was the most frequently identified method for aligning activities with the standards and accounted for 64.7% ($n = 11$) of all activities posted.

Comparing the bloggers (posted at least one comment) to the non-bloggers (did not post a comment) at baseline ESBI produced a small effect size favoring the bloggers (e.s.=.24), while TESPE produced a small effect size (e.s.=.35) favoring the non-bloggers. Based on ESBI, bloggers ($n = 15$) increased self-efficacy from baseline to end (ESBI baseline $M = 72.50$, $SD = 10.45$; end $M = 86.94$, $SD = 6.81$, e.s.=1.64) more than non-bloggers (n=20) (ESBI baseline $M = 69.57$, $SD = 18.16$; end $M = 81.02$, $SD = 10.47$, e.s.=.77). TESPE produced a moderate effect size (.75) over time for the bloggers. No other effect sizes were moderate or large. Three separate independent t-tests using end self-efficacy as the dependent variable and number of blog comments as the independent variable indicated no differences between groups for end ESBI ($t(2)=1.77$, $p=.09$), TESPE ($t(2)=-.96$, $p=.34$) or TSES ($t(2)=1.69$, $p<.10$) self-efficacy scores. The majority of bloggers (80%, n=12) completed the study.

Pearson product-moment correlation analyses were computed to identify whether or not self-efficacy characteristics were related to collaboration as measured by weblog use (Table 2). The correlation analysis revealed a number of statistically significant positive relationships. Number of individual blog comments was significantly related to post-ESBI score ($r=-.57$, $p<.05$) and post-TSES score ($r=.49$, $p<.05$). At the district level, total number of district blog views was significantly related to pre-ESBI score ($r=.41$, $p<.05$) and pre-TESPE score ($r=.34$, $p<.05$)

Table 2: Pearson-product correlations among blog use, education level and self-efficacy assessments.

Variable	1	2	3	4	5	6	7	8	9	10
1. Individual BC	-									
2. District BV	-.02	-								
3. Rating	-.29	.17	-							
4. Pre-ESBI	-.14	-.41*	-.03	-						
5. Pre-TESPE	.31	-.34*	-.07	.56**	-					
6. Pre-TSES	-.13	-.23	-.18	.49**	.53**	-				
7. Post-ESBI	.57*	.03	.32	-.13	-.11	.07	-			
8. Post-TESPE	-.17	-.10	-.00	-.11	-.07	-.22	.16	-		
9. Post-TSES	.49*	-.08	.08	-.12	.20	.09	-.25	-.08	-	
10. Educ. Level	-.02	.03	-.06	-.20	.16	-.01	-.18	.20	.03	-

Note: *$p<.05$, two-tailed. **$p<.01$, two-tailed

BV = Blog Views, BC = Blog Comments, Educ. Level = Education

The baseline and end TESPE and ESBI subscales for "planning" were examined using Pearson-product correlation to assess whether or not they assessed similar constructs. Baseline TESPE was significantly related to end TESPE ($r=.41$, $p<.01$) and baseline ESBI ($r=.54$, $p<.01$) but unrelated to end ESBI ($r=.12$, $p=.42$). Approximately 90% (n=24) of the experimental group increased ESBI score from pre- to post while 57% ($n = 12$) of control group showed an ESBI increase.

4.1 Discussion

The purpose of this study was to test Bandura's social

cognitive theory as a means to improve physical education teacher efficacy for standards-based physical education. The intervention used two strategies; a face-to-face meeting and the internet for reminders and blogging. Each strategy addressed one or more components of Bandura's model and the framework of information and experiences that contribute to self-efficacy. Quality physical education is a key strategy for increasing physical activity among children and adolescents. Standards-based physical education is one of four characteristics of quality physical education [1]. Self-efficacy has been consistently identified as predictive of student outcomes. Therefore, an intervention that increases teacher self-efficacy has the potential to impact physical activity in students through quality physical education.

4.2 Increases in self-efficacy

The results of this study underscore the important role professional development opportunities in physical education provide for establishing teachers' efficacy beliefs. A significant interaction (group by time) for ESBI demonstrated that the intervention group increased self-efficacy while the control group did not. The intervention targeted standards-based physical education, and the ESBI was specifically designed to examine teacher efficacy for using standards. The effect size for the intervention group was large as were all subtest effect sizes for the intervention group. The control group did not increase efficacy over time and pre-to-post effect sizes were small for all tests and subtests of self-efficacy (ESBI, TESPE and TSES). A host of personal, social, and situational factors affect how direct and socially mediated experiences are cognitively interpreted. Increased ESBI self-efficacy levels among the experimental group in this study suggest the intervention was successful in organizing mastery experiences, which were conducive to the acquisition of standards-based knowledge and skills. Approximately 90% (n = 24) of the experimental group increased ESBI score from pre- to post while 57% (n = 12) of control group showed an ESBI increase. Efficacy appraisals are partly influenced by vicarious experiences mediated through modeled attainments [3]. Since vertical alignment of standards and benchmarks is a shared responsibility, how well districts performed as a group in their vertical alignment may have partially determined individual self-efficacy. Improvement in self-efficacy levels was not limited to those who were initially low in self-efficacy. Consistent with Bandura [3], even those who were highly self-assured increased their self-efficacy beliefs.

Two previously developed self-efficacy instruments (TSES and TESPE) were selected for this study because they have received some support [28, 29] and have been used in physical education research. However, they do not fully meet Bandura's [13] guidelines for developing self-efficacy scales. Therefore, the ESBI was devised from PECAT objectives to rate physical educator's confidence in their ability to align district standards, benchmarks, lessons, and assessments according to Bandura's criteria.

The TESPE and TSES scales criteria were not altered in this intervention and that may have decreased the change potential. Mean TESPE and TSES self-efficacy levels did not change in either the experimental or control condition. This was expected because previous literature suggests teacher self-efficacy scales have been "plagued" by methodological and conceptual shortcomings [24]. Further, the data may suggest that professional development in the form of one face-to-face meeting was not enough to influence general self-efficacy for teaching or teaching physical education.

4.3 Collaboration and self-efficacy

Almost half (48%) of the experimental teachers participated in the blog. This virtual collaboration was associated with greater increase in ESBI self-efficacy (e.s. = 1.64) when compared to the entire experimental group (e.s. = .97) or the non-bloggers in the experimental group (e.s. = .77). This suggests the professional development meeting coupled with six-week collaboration in virtual space was more effective than the professional development meeting alone. It is noteworthy that the change in self-efficacy occurred in just six weeks with relatively little intervention. These results have specific implications for methods of teacher education in that weblogs can be used to engage teachers in meaningful activity to improve their confidence in teaching and planning for standards-based instruction. This work supports the idea that self-efficacy is very specific. For example, there were three measures of self-efficacy used in the current study. At baseline the three measures produced significant correlations accounting for 24-31% of the variance. This suggests that prior to the intervention the instruments captured the same portion of general self-efficacy. By the end of the intervention the three measures were not significantly correlated with each other.

Previous studies indicate teacher efficacy has been linked to teacher's willingness to experiment with new methods [9, 12] and their commitment to their field [10]. Standards-based vertical alignment represented a new method for the majority of teachers in this study. Collaboration in virtual space served as a proxy for measuring teacher commitment. Some aspects of self-efficacy were incorporated into online collaboration in the current study; individual blog use was related to post ESBI and post TSES self-efficacy. Blog comments and self-efficacy shared 24-33% of the variance in common at the end of the study. The mechanisms underlying these relationships are still unclear. A lower sense of self-efficacy at baseline may have sent participants searching for vicarious, verbal and other sources of support.

Virtual space statistics indicate districts with teachers higher in baseline self-efficacy viewed the online blog more frequently (Table 2). Physical education teachers working collaboratively with universities, often in the form of professional development, report that they are rejuvenated and empowered [24] .The results of this study are mixed; the experimental group showed a benefit of collaboration however the control group did not. Both groups reported having viewed the training sessions positively.

Blog views and baseline ESBI (r=-.41, p<.05) and TSES (r=-.34, p<.05) were related such that low baseline efficacy was associated with more views. This might suggest that less empowered teachers were seeking information from colleagues or seeking collaboration; the views of these teachers were invisible to their colleagues. The blog may have allowed them to seek information and support privately and without fear of disclosure. Blog views were not associated with any post-efficacy measures, thus suggesting that views are not sufficient to fill the vicarious experience role necessary to influence self-efficacy. The relation between individual blog comments posted and end ESBI (r=.57, p<.05) and post TSES (r=.49, p<.05) indicated that as the number of blog comments increased, self-efficacy also increased. Thus, engagement in blogging activity was one factor contributing to increased self-efficacy beliefs for curricular decisions. The collaborative blog may have served as a resource for influencing self-efficacy beliefs for participants electing to use it. Posting blog comments

appeared to be sufficient to provide vicarious experience. Consistent with previous physical education literature [22, 23], participants in the current study did not collaborate with colleagues—as evidenced by the low virtual space participation rates (less than 50% of participants posted a single blog comment despite weekly reminders). Bandura [3] asserts teaching efficacy varies across grade levels and subjects but grade level had no apparent effect on physical educator self-efficacy in the current study. Physical educators are often isolated and collaborations often are limited because professional development may not be subject specific.

The development of physical educator self-efficacy is a dynamic process involving changes in beliefs as a result of teacher participation in standards-based intervention of mastery, vicarious, persuasive, and physiologically arousing experiences. A key finding is that collaboration in virtual space significantly and meaningfully increased physical educator self-efficacy. An integrated model of physical education teacher self-efficacy is essential for capturing the complex relationships among the beliefs of teachers about their teaching abilities, behavior, and environment. The protocol developed for this study has demonstrated effectiveness in increasing physical educator self-efficacy for curricular decisions and may serve as a guide for future professional development opportunities in physical education where the goal is to improve curricular decisions, collaboration, and/or self-efficacy.

4.4 Drop-outs

Some participants in both the intervention and control groups did not complete the study. The major concern with missing data was whether or not the loss of participants biases the results. Three factors suggest there was no bias based on the drop-outs. First, the measures of primary interest (self-efficacy) indicated that the drop-outs were not different from those completing the study. Second, the drop-out rates were similar between the intervention and control groups.

4.5 Limitations

Self-efficacy measures were collected at the beginning of a physical education face-to-face meeting and six weeks after the meeting. It would have been helpful to administer an additional efficacy measurement immediately after the face-to-face meeting and before the collaboration in virtual space to distinguish between experimental effects of the face-to-face meeting and collaboration in virtual space. The latest generation of collaborative web-based tools (i.e. blogs) offer many unique and powerful information sharing and collaborative features. Research is still needed to determine the best ways to leverage this emerging tool to boost teaching, learning, collaboration, and self-efficacy. Future work should explore if and how physical education ESBI self-efficacy is related to teacher practice and ultimately student learning. Follow-up studies could have two separate interventions (i.e. three ARMS: a control, a blog intervention only and an in-person intervention only). Finally, it remains unknown how long the increases in self-efficacy will endure.

5. Conclusions

In summary, this study demonstrates support for the use of Social Cognitive Theory as the theoretical model for developing interventions to increase physical education teacher self-efficacy. This work confirms the work of Weiss [31] in that teacher self-efficacy was supported through positive collaboration with other educators but is the first to use physical educator self-efficacy as a dependent variable. Three instruments developed to measure self-efficacy (TSES, TESPE and ESBI) captured a type of self-efficacy toward teaching. However, each instrument is probably best used in specific applications consistent with the intended purpose of the instrument. Finally, the relative success of the blog in enhancing self-efficacy suggests that virtual collaboration and training has potential to address issues of concern to physical educators including lack of training on physical education topics and professional isolation.

6. References

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