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UNIVERSITY OF CALIFORNIA
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Using a Brief Web-Based, On Demand Training to Improve Pre-Service Teacher
Knowledge of Attention Deficit Hyperactivity Disorder (ADHD)

A Thesis submitted in partial satisfaction
of the requirements for the degree of

Master of Arts

in

Education

by

Elissa M. Monteiro

June 2021

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June 2021

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ABSTRACT OF THE THESIS

Using a Brief Web-Based, On Demand Training to Improve Pre-Service Knowledge of Attention Deficit Hyperactivity Disorder (ADHD)

by

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Master of Arts, Graduate Program in Education
University of California, Riverside, June 2021
Dr. Wesley Sims, Chairperson

Teachers play an essential role in supporting children with ADHD and are often responsible for implementing the classroom-based interventions designed to bolster the academic and behavioral success, and the socio-emotional development of children with ADHD in schools. Unfortunately, several studies suggest teachers are inadequately prepared to take on this role. Evidence suggests there are widespread gaps in teacher knowledge about the meaning of a diagnosis of ADHD and evidence-based interventions used to support children with ADHD in schools. The main purpose of this study is to examine the effectiveness of a virtual, self-paced professional development seminar for pre-service teachers. The webinar will be aimed at improving pre-service teacher knowledge about the diagnosis of ADHD, characteristics of students with ADHD in the classroom, and evidence-based interventions that can be used to alleviate academic and behavioral problems often experienced by students with ADHD. The webinar also aims to increase pre-service teachers' self-efficacy as it relates to supporting children with ADHD.

Table of Contents

Introduction	1
Difficulties Experienced by Students with ADHD	2
Supporting Students with ADHD	3
Difficulties Experienced by Teachers Supporting Students with ADHD	4
Teachers' Self-Efficacy	7
ADHD Focused Training	9
Current Study	13
Methods	14
Participants	14
Table 1	16
<i>Participant Demographic Information</i>	16
Measures	17
Procedures	21
Results	26
Knowledge of ADHD	26
Table 2	27
<i>Total Scores on the Knowledge of Attention Deficit Disorder Scale</i>	27
Educator Misconceptions About ADHD	28
Pre-Service Teacher Self-Efficacy	30
Social Validity	32
Discussion	33

Limitations and Future Directions	38
Limitations	38
Future Directions	40
Implications	42
References	43

List of Tables

Table 1. Participant Demographic Information.....	16
Table 2. Total Scores on the Knowledge of Attention Deficit Disorder Scale	27
Table 3. Misconception Scores on the Knowledge of Attention Deficit Disorder Scale.	28
Table 4. Average Scores on the Teacher Self-Efficacy Scale.....	30
Table 5. Ratings on the User Rating Profile-Web Resource.....	32

List of Figures

Figure 1. The Effect of Training on Participants' Overall Scores on the Knowledge of Attention Deficit Disorder Scale.....	27
Figure 2. The Effect of Training on Participants' Misconceptions about ADHD	29
Figure 3. The Effect of Training on Participants' Average Ratings on the Teacher Self-Efficacy Scale	30

Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) remains one of the most common neurobehavioral disorders in children, affecting approximately 4% to 12% of school-age children worldwide (Polanczyk et al., 2007). According to Diagnostic and Statistical Manual, Fifth Edition (DSM-5; American Psychological Association, 2013), ADHD is a neurodevelopmental disorder characterized by pervasive and impairing symptoms of inattention, hyperactivity, and/or impulsivity that impairs functioning in at least two settings (e.g., home, school). ADHD significantly impacts an individuals' behavioral, social, and academic functioning (Klinger, 2002).

Children and adolescents with the disorder frequently experience educational difficulties (Loe & Feldman, 2007), problems with self-esteem (Bussing et al., 2000), significantly impaired family and peer relationships (Hoza, 2007), and an overall lower quality of life (Coghill, 2010). ADHD-related impairments persist across the lifespan and may underlie subsequent problems in adulthood such as occupational difficulties, criminal activity, substance abuse problems, and traffic accidents and citations (Hodgkins et al., 2012). Moreover, the difficulties faced by children and adults with ADHD may have spillover effects that can negatively impact the health and work productivity of family members (Birnbaum et al., 2005). The latter is an especially salient concern during the COVID-19 pandemic where many families across the country and the world have been confined to one household due to virtual work environments and distance learning. A study surveying the top problems adolescents and young adults with ADHD experienced during the COVID-19 pandemic highlighted the significant challenges

students with ADHD experience during online learning including social isolation, motivation problems, boredom, and difficulty remaining academically engaged (Sibley et al., 2021). This is just one relevant example of the long-lasting call for the need to increase teacher knowledge about ADHD in order to effectively support students' academic and behavioral difficulties (Kos et al., 2006).

Difficulties Experienced by Students with ADHD

The majority of students with ADHD exhibit difficulties in academic performance (Barry et al., 2002; Birchwood & Daley, 2012) and difficulties with academic engagement (Vile Junod et al., 2006) in the classroom. High rates of comorbidity also compound the challenges experienced by students with ADHD; it has been estimated up to 70% of these students have a learning disorder (Mayes & Calhoun, 2006). Academic challenges can be exacerbated by symptoms of ADHD, including inattention, disorganization, and tendency to engage in off task behaviors (Langberg et al., 2011). Students with ADHD are more likely to have poorer grades, be identified for special education (Loe & Feldman, 2007), and are at higher risk for being retained and for dropping out of high school (Barbarese et al., 2007; Galéra et al., 2009). Additionally, several students with ADHD experience behavioral problems, including aggression and noncompliance (Barkley, 2006), as well as social impairment, characterized by difficulty interacting with peers and adults. Given these compounded difficulties, it is imperative that schools effectively support the academic, behavioral, and socioemotional development of students with ADHD.

Supporting Students with ADHD

Several interventions exist to support the academic and behavioral success of students with ADHD. A meta-analysis conducted by DuPaul and colleagues (2012) suggests that overall, school-based interventions for students with ADHD have a significant and positive effect on students' academic and behavioral outcomes. In this study, academic interventions focused on manipulating antecedent conditions like academic instruction (e.g., peer tutoring) or academic materials (e.g., organizational skills). Contingency management interventions used reinforcement (e.g., praise) or punishment (e.g., corrective feedback) to shape desired behaviors. Cognitive behavioral interventions focused on developing students' self-control skills and reflective problem-solving strategies (e.g., self-management system). Results of this study revealed that combined academic and contingency management interventions yielded the greatest effects on student outcomes. Effect sizes for cognitive behavioral interventions were smaller relative to both categories of interventions. Another key finding that emerged from this study was that interventions implemented in general education classrooms yielded similar effects for both academic and behavioral outcomes relative to strategies used in special education (DuPaul et al., 2012). This is notable due to the fact that students with ADHD typically spend the majority of their time in general education classrooms receiving "push in" services (Turnbull et al., 2004).

There are two main mechanisms through which educational supports are provided to students with ADHD: Section 504 of the Rehabilitation Act of 1973 and Individuals with Disabilities Education Improvement Act (IDEA, 2004). In one study researchers

found that just over half of the students with a diagnosis of ADHD had an IEP or 504 plan (Murray et al., 2014). Although the majority of students with ADHD currently receive support in school, previous studies have found that at least one in five students with ADHD do not receive specialized services (DuPaul et al., 2019). Unfortunately, despite calls for use of evidence-based interventions for students with ADHD in schools (DuPaul et al., 2012; Gaastra et al., 2016; Purdie et al., 2002), evidence suggests that at least one in five students experiencing significant academic and social difficulties with ADHD do not receive evidence-based support services (DuPaul et al., 2018). Taken together, the opportunity to improve identification of students with ADHD and delivery of evidence-based support services is likely to improve students' educational trajectories. Such activities depend almost exclusively on the adults that surround students with ADHD, illustrating the importance of well-trained, well-supported teachers and support staff in recognizing and managing (i.e., implementing supports) symptomology or behavioral correlates associated with ADHD.

Difficulties Experienced by Teachers Supporting Students with ADHD

Given the large number of students with ADHD in schools and the mechanisms in place for supporting students with ADHD, teachers play an essential role in guiding the identification and support processes for these students. Teachers are often tasked with referring students who are at-risk of falling behind, in addition to implementing interventions to support previously identified (i.e., diagnosed) students' success (Groenewald et al., 2009; Topkin et al., 2015). Practically, teachers are often tasked with implementation and progress monitoring of interventions. Unfortunately, current

evidence suggests that teachers may be inadequately prepared (i.e., limited training) to support students with ADHD effectively (Martinussen et al., 2011). Teachers must have both knowledge of the child and knowledge of ADHD in order to appropriately select an effective intervention for their student. Additionally, teaching experience and teachers' personality may serve as factors that influence the effectiveness of classroom interventions for children with ADHD (Gaastra et al., 2016). Given these factors and the challenges experienced by students with ADHD, teachers consistently report that children with ADHD are more stressful to teach (Greene et al., 2002).

This stress is likely compounded by difficulties related to inadequate training. Several studies suggest there are gaps in teacher knowledge and perceptions about the diagnosis of ADHD itself (DuPaul & Eckert, 1997; Gaastra et al., 2016) and about evidence based interventions used to support children with ADHD (Arcia et al., 2000; Lawrence et al., 2017; Vereb & DiPeina, 2004). Recent studies identified the presence of gaps in teacher knowledge of ADHD symptoms (Guerra et al., 2017; Sciutto et al., 2016), as well as insufficient knowledge about evidence-based interventions that can be used to support students with ADHD (Arcia et al., 2000; Lawrence et al., 2017; Vereb & DiPerna, 2004). There exists some disagreement in the literature regarding teachers' level of ADHD knowledge based on their responses on a 20-item true/false response scale (Barbaresi & Olsen, 1998; Jerome et al., 1994; Ohan et al., 2008). However, the dichotomous scale used to measure teacher knowledge in these studies carries some constraints, particularly because with a true/false response format respondents have a 50% chance of guessing the correct response. This scale could lead to potentially inflated

or otherwise inaccurate estimate of teachers' ADHD knowledge (Soroa et al., 2013). An alternate measure developed by Scituito and colleagues (2000), the Knowledge of Attention Deficit Disorder Scale (KADDS; KADDS; Scituito et al., 2000), addresses this limitation by utilizing a three-option response format (i.e., true, false, don't know) that allows for differentiation of what respondents correctly know, what they do not know, and what they believe incorrectly (Soroa et al., 2013; Scituito et al., 2000).

Many studies that have used the KADDS to describe teacher knowledge about ADHD have found lower levels of ADHD knowledge among teachers, ranging between 15% and 62% correct (Alkahtani, 2013; Anderson et al., 2012; Bradshaw & Kamal, 2013; Guerra & Brown, 2012; Perold et al., 2010; Scituito et al., 2016; Topkin et al., 2015; Youssef et al., 2015). The low levels of knowledge described are not surprising given the consistent teacher reported deficiencies in their training on ADHD related topics (Bekle, 2004; Bussing et al., 2002; Jerome et al., 1994; Jones & Chronis-Tuscano, 2008; Martinussen et al., 2011). Lack of knowledge related to ADHD diagnostic symptoms, associated features, and treatment has long been identified as one of the greatest impediments in teachers being able to attend to the additional needs of students with ADHD (Shapiro & DuPaul, 1993). This is especially disappointing considering the strong evidence base supporting the efficacy of school-based interventions for students with ADHD.

Another facet of ADHD knowledge measured by the KADDS is the misconceptions that individuals may have about ADHD. Misconceptions are likely developed by colloquial discussions about ADHD and the publicization of ADHD in

popular media (Mueller et al., 2012). Evidence suggests that teachers are not immune to adopting these misconceptions, even when the teacher has some accurate knowledge of ADHD (Arcia et al., 2000). For example, a commonly held misconception identified by teachers is that ADHD symptoms are caused by poor diet or poor parenting (Barbaresi & Olsen, 1998; Jerome et al., 1994). Another example, Stampoltzis & Antonopoulou (2013) found that teachers wrongly believed that ADHD does not have a hereditary basis. The adoption of misconceptions by teachers is a widespread finding across countries (Aguar et al., 2014; Bekle, 2004; Sciutto et al., 2000; Stampoltzis & Antonopoulou, 2013). These misconceptions combined with feelings of under preparedness (i.e., deficiencies in training) to support the unique challenges faced by students with ADHD can have disastrous effects on teachers' perceptions of their abilities to be effective in their classrooms. Decreased self-efficacy can exacerbate the negative affect that likely accompanies attempts to support students with ADHD when ill-prepared to do so. As noted previously, for many classroom educators, this may lead to a premature and rapid departure from the teaching profession.

Teachers' Self-Efficacy

An important indicator of teachers' training and eventual practice is teacher self-efficacy. Teacher self-efficacy is defined as a teacher's beliefs in their capabilities to organize and implement strategies that bring about desired outcomes of student engagement and learning (Bandura, 1977; Tschannen, Moran, & Hoy, 2001). Evidence suggests pre-service teachers' self-efficacy is malleable during their teacher education programs. Pre-service teachers tend to report higher levels of teaching self-efficacy at the

end of their formal training, compared to their reported levels of teaching self-efficacy when beginning their program (Gordon & Debus, 2002; Lin et al., 2002; Woolfolk Hoy & Burke Spero, 2005). Examining perceptions of self-efficacy in pre-service teachers, both generally and within more specific teaching tasks (i.e., engaging students, managing the classroom, and enlisting various instructional strategies), during teacher preparation is important because pre-service teachers' self-efficacy beliefs are malleable early on in learning (Bandura, 1977). Previous literature suggests that teachers with higher self-efficacy are more willing to implement new methods to respond to students' diverse needs (Berman et al., 1977) and are more likely to refer a student with difficulties for additional assistance (Podell & Soodak, 1993). Teachers with low self-efficacy tend to report more classroom disturbances and higher levels of emotional exhaustion (Dicke et al., 2014) which may, in part, be due to teachers' limited preparedness and thus their self-efficacy for supporting students with ADHD in the classroom.

The Teacher Self-Efficacy Scale (TSES; Tschannen-Moran & Woolfolk Hoy, 2001) is an instrument that is often used to measure the teaching self-efficacy of pre-service teachers (Capa Aydin & Woolfolk Hoy, 2005; Fives & Buehl, 2010; Knoblauch, 2006; Knoblauch & Woolfolk Hoy, 2008; Larson & Goebel, 2008; Martinez, 2003; Poulou, 2007). An early paper by Sciutto et al. (2000) suggested a correlation between teacher self-efficacy and ADHD knowledge. This finding was supported in a study by Legato (2011) which found that ADHD knowledge and self-efficacy were positively correlated with each other, where increased ADHD knowledge was associated with higher self-efficacy. Very few studies to date have measured teacher self-efficacy

alongside an intervention to improve teachers' knowledge about ADHD and the difficulties students with ADHD experience. This is a glaring problem given that self-efficacy is likely salient for predicting whether the teacher might actually implement the strategies they learned about in the ADHD professional development training.

Latouche & Gascoigne (2017) were the first, and only research group thus far, to evaluate the impact of an ADHD training intervention on teachers' self-efficacy. The study found that a brief in-service workshop increased primary school teachers' ADHD knowledge and sense of self-efficacy immediately following the training. Further, both ADHD knowledge and teachers' ratings of self-efficacy remained higher at the 1-month follow-up compared to pre-intervention ADHD knowledge. To bolster understanding of the effects of pre-service teacher training on perceived self-efficacy in supporting students with ADHD, this study will use the TSES to measure pre-service teacher self-efficacy before and after a brief training.

ADHD Focused Training

At the core of teacher efficacy is the depth and breadth of teachers' professional preparation. The majority of teachers report that they did not have ADHD related coursework in their undergraduate or graduate training (David, 2013; Guerra et al., 2012). Teachers consistently report they do not receive the necessary training to effectively manage students exhibiting problematic behavior in classrooms (Begeny & Martens, 2006; Christofferson & Sullivan, 2015; Freeman et al., 2014; Wagner et al., 2006), including students with ADHD (Topkin & Roman, 2015). There is a well-documented need for the development of effective pre- and in- service training programs to increase

teachers' competence about ADHD (Guerra et al., 2017). Previous research surveying teachers' ADHD knowledge suggests that teachers lack knowledge about the symptoms of ADHD, educational interventions for students with ADHD, and the challenging outcomes students with ADHD experience (Guerra & Brown, 2012; Guerra et al., 2017). Given that ADHD tends to present in the early school years (Barkley, 1998), primary school teachers are most likely to be the first people to identify students with ADHD (Tannock & Martinussen, 2001). Therefore, it is essential teachers understand the symptoms and associated characteristics of ADHD.

Furthermore, teachers have pointed to the lack in administrative support at their schools as challenges for implementing school-based interventions for students with ADHD (Guerra et al., 2017). It has been argued that teachers who have an improved understanding of students with ADHD may feel more empowered to support them (Holz & Lessing, 2002) and may be more likely to implement necessary classroom interventions with improved adherence and fidelity (Shah et al., 2016). Importantly, previous literature suggests teachers who receive minimal training as pre-service teachers tend to have negative attitudes towards students with disabilities (Rubie-Davies et al., 2012; Tiwari et al., 2015). Considering the potentially harmful effects deficiencies in knowledge as well as misconceptions that some teachers may hold about students with ADHD, increasing and improving preparation in this area appears advantageous.

Historically, literature suggests comprehensive ADHD training includes coverage of the symptoms associated with ADHD and evidence-based treatments used to support individuals with ADHD. The importance of content in these areas is also seen in their

alignment with factors assessed by the KADDS (i.e., Symptoms and Diagnosis, Treatment, and Associated Features). Symptoms and Diagnosis includes knowledge of the primary symptoms of ADHD (e.g., frequently distracted by extraneous stimuli) as well as distinctions from other disorders (e.g., physical features detected by a medical doctor can be used to make a diagnosis of ADHD). Content related to Treatment covers information about commonly used treatments for ADHD (e.g., stimulant medication) as well as misconceptions about treatments (e.g., psychotherapy alone is sufficient, reduction of sugar intake will reduce symptoms of ADHD). Associated Features covers symptoms associated with ADHD (e.g., fidgeting) and misconceptions about perceptions of students with ADHD (e.g., stealing, physically cruel to others). In turn, these concepts guided the development of the brief, web-based on-demand ADHD training employed in this study.

Empirical Support for ADHD Training

To date, studies that have evaluated training activities aimed at increasing teachers' ADHD knowledge are few in number and small in effect. In the first randomized control study examining a brief in-service training for teachers on ADHD (n = 142), Jones and Chronis-Tuscano (2008) found a very small increase in teachers' ADHD knowledge, although high pre-intervention knowledge levels may have contributed to this modest result. Jones and Chronis-Tuscano (2008) did not report the length of their intervention. A similar study by Syed and Hussein (2009) also found small increases in teachers' ADHD knowledge following their intervention, although the majority of these gains were lost at the 6-month follow-up. Syed and Hussein's (2009)

workshop was time (i.e., five 2-hour workshops) and labor intensive (i.e., three facilitators), which may limit feasibility. Syed and Hussein's (2009) ADHD knowledge intervention study is one of few studies that have collected follow-up data post-intervention. This nascent research in follow-up data after professional development training studies is a glaring problem for this body of research.

In Brazil, a study by Aguiar et al. (2014) implemented a 1-day, 6-hour training workshop on ADHD and learning disorders for teachers (n = 37). These results were comparable to Syed and Hussein (2009), a modest increase in ADHD knowledge, these results support the use of a shorter 6-hr workshop that is more efficient and practical. An important finding given that interventions delivered over several days may not be suitable for teachers' busy schedules (Aguiar et al., 2014). Neither Syed and Hussein (2009) nor Aguiar et al. (2014) utilized a control group in their respective studies. Overall, only negligible to small improvements in ADHD knowledge have been found in current studies, with methodological issues limiting the strength of these findings.

Improving ADHD Training

Ultimately, increasing teachers' ADHD knowledge should better equip teachers to identify, manage, and effectively support students with ADHD in their classrooms. Training may also help teachers maintain their feelings of competence, a potential proxy for self-efficacy, and a conviction in the effectiveness of their actions, despite facing behavioral and classroom management challenges (Latouche & Gascoigne, 2019). One potential remedy for noted deficits in teacher ADHD training is the use of web-based, easily consumable professional development modules (i.e., webinars; Corkum et al.,

2019). Given the rise in technology use and information dissemination via the internet, the use of webinars to increase pre- and in-service teacher knowledge of ADHD symptoms, diagnosis, and treatment in schools is advantageous and timely. To this end, the present study aimed to evaluate the impact of an ADHD focused webinar on the basic knowledge about identification and interventions for students with ADHD of pre-service teachers.

Current Study

This study evaluated the impact of a brief virtual webinar covering diagnostic criteria for ADHD, assessment of ADHD symptoms, and the variety of choices of effective school-based interventions for students with ADHD on pre-service teacher knowledge of in these areas. Broadly, this study will build on work by Latouche & Gascoigne (2017) by measuring both teacher knowledge and self-reported efficacy in working with students with ADHD alongside the implementation of a brief web-based, self-paced ADHD teacher training aimed to educate pre-service teachers. Few studies have measured ADHD knowledge, using the KADDS, and alongside self-efficacy. Even fewer studies have extended this line of research to pre-service teachers. Study objectives included: (a) to measure the baseline ADHD knowledge and teaching self-efficacy of a sample of pre-service teachers, (b) to evaluate the effectiveness of the ADHD training webinar by measuring pre-service teachers' ADHD knowledge and self-efficacy directly after the delivery of the webinar, and (c) to assess social validity of the training.

Research Hypotheses

1. Pre-service teacher knowledge of ADHD symptomology (i.e., identification), diagnostic processes and procedures, and evidence-based intervention practices will increase following participation in this brief virtual webinar. Significant improvements are anticipated in pre-service teacher KADDS scores following completion of a 2-hour ADHD webinar.
2. Pre-service teacher misconceptions of ADHD will improve following participation in this brief virtual webinar. Significant improvements are anticipated in pre-service teacher KADDS scores following completion of a 2-hour ADHD webinar.
3. This brief webinar on ADHD will increase pre-service teacher perceptions of self-efficacy in working with students with ADHD. Significant improvements are anticipated in pre-service teacher TSES scores following completion of a 2-hour ADHD webinar.
4. Pre-service teachers will perceive this ADHD webinar as socially valid. Participant ratings of the usability, feasibility, and acceptability of this webinar will be evidenced by favorable ratings on the User Rating Profile-Web Resource (URP-WR; Mandracchia & Sims, 2020).

Methods

Participants

Approval of all study activities was acquired from the University of California Riverside Institutional Review Board. This study recruited pre-service teachers at the

University of California-Riverside. Study eligibility was based on potential participants status as a “pre-service teacher.” Pre-service teachers were defined as 1) senior undergraduate students who applied to the teacher credential program or 2) undergraduate students accepted into the teacher credentialing program. Data from 71 participants were used in analyses.

The majority of participants were female (90%) and Hispanic/Latina (48%). Most pre-service teachers in this sample reported that they intend to continue their careers in the general education setting (85%). Regarding previous experience with and exposure to ADHD, 23% of the participants reported having some experience working with children who had been diagnosed with ADHD (i.e., 1-2 students, 18%; 3-4 students, 1%; more than 5 students, 4%). Additionally, 42% of participants reported taking a course where they learned about the diagnosis itself, the difficulties students with ADHD face, or educational interventions used to support students with ADHD (i.e., 1-2 courses, 36%; 3-4 courses, 6%). Demographic information for this sample of pre-service teachers is presented in Table 1.

Table 1*Participant Demographic Information*

	n	%
Gender		
Female	64	90
Male	5	7
Gender Variant/ Nonbinary/Nonconforming	2	3
Race & Ethnicity		
Hispanic, Latino, or Spanish origin	34	48
Asian	24	34
White, non-Hispanic	9	13
Black or African American	1	1
Other	3	4
Future Plans		
General Education	60	85
Special Education	11	16
Previous Experience with ADHD		
Worked with diagnosed students	17	23
Exposed through coursework	30	42

Measures

Demographic Information

Demographic Questionnaire. Preservice teachers completed a 10-item, study specific questionnaire containing items that asked about participants' sex, age, completion of university studies that covered information about ADHD, exposure to information about ADHD in the last 12 months, and primary versus secondary teacher status. Teachers were also asked what grade(s) they intend to teach, what subjects they intend to teach, and whether they intend to teach in a general education or a special education setting. With regard to ADHD, participants were asked whether they received any coursework on ADHD and education-related subject matters and whether they ever worked with a child who they knew was diagnosed with ADHD.

ADHD Knowledge

Knowledge of Attention Deficit Disorders Scale. The KADDS (Sciutto et al., 2000) is a 36-item rating scale designed to assess knowledge of ADHD. Each KADDS item prompts the respondent with a statement about ADHD and respondents use a true (T), false (F), or don't know (DK) format to answer each item. This format allows for differentiation of what teachers *do not know* from what they believe incorrectly (i.e., misconception). The KADDS measures knowledge and misconceptions of ADHD in three specific areas: *Symptoms/ Diagnosis* of ADHD, *Treatment* of ADHD, and *Associated Features* (i.e., general information) including the nature, causes, and outcomes of ADHD. These subscales were chosen by Sciutto and colleagues (2000) to

reflect content areas relevant to educational professionals. For the purposes of the present study, the author computed two separate scores: *Misconceptions* (i.e., total number of incorrect answers) and *Knowledge* (i.e., total number of correct answers). For example, if a preservice teacher answered 15 items correctly, 10 incorrectly, and chose “*Don’t Know*” for 11 items, their knowledge score would be 15 and their misconceptions score would be 10. “*Don’t Know*” responses are scored separately from the knowledge and misconception scores, “*Don’t Know*” responses are not scored as correct or incorrect.

In previous studies with U.S. samples, internal consistency of the KADDS total score has ranged from .82 to .89 (Sciutto et al., 2004). Subscale reliability is more variable and tends to be lower ($.52 < \alpha < .75$). Two-week test-retest correlations for the KADDS total and subscale scores are moderate to high ($.59 < r < .76$; Sciutto & Terjesen, 2006). With regard to validity, prior research with U.S. samples suggests that the KADDS scores are sensitive to educational interventions (see Sciutto & Terjesen, 2006) and are positively related to the extent of prior experience with ADHD students (see Sciutto et al., 2004), confidence in recognizing ADHD (see Herbert et al., 2004), and the amount of exposure to research or courses on ADHD (Sciutto et al., 2004). In previous studies assessing individuals’ knowledge of ADHD, higher KADDS scores have been associated with greater prior exposure to children with ADHD, general level of training (i.e., in-service vs. preservice), and greater exposure to information about ADHD (Fernández & Mínguez, 2007; Hepp, 2009; Perold et al., 2010).

Teacher Self-Efficacy

Teacher Self-Efficacy Scale. The TSES (Tschannen-Moran & Woolfolk Hoy, 2001) is a standardized assessment used to measure teachers' self-efficacy regarding working with students with ADHD pre- and post- training. This study used the long form of the TSES, as recommended by the developers of the TSES when working with pre-service teachers, as a buffer against overlapping factor structure when studying preservice teachers (see Fives & Buehl, 2009). The long form of the TSES includes 24 items. Previous factor analyses using pre-service teacher samples have concluded that a 1-factor model resulted in a better fit compared to a three factor model used with in-service teachers (Duffin et al., 2012). Therefore, a unitary construct of self-efficacy is more appropriate for pre-service teachers who might lack the experience necessary to distinguish between the many tasks involved in teaching. Evidence suggests a differentiated factor model with subscales for *Efficacy in Student Engagement* (e.g., How much can you do to motivate students who show low interest in school work?), *Efficacy in Instructional Practice* (e.g., How much can you do to adjust your lessons to the proper level for individual students?), and *Efficacy in Classroom Management* (e.g., How much can you do to get children to follow classroom rules?) is a better fit for more experienced teachers (Fives & Buehl, 2009; Tschannen-Moran & Woolfolk Hoy, 2001). While the items themselves were not altered, participants were prompted to "Please respond with students with ADHD in mind specifically. For example, when asked 'How much can you do to motivate students who show low interest in schoolwork?' answer the question as if the 'students' the question is inquiring about are students with ADHD." Participants

responded on a 9-point continuum ranging from nothing (1) to a great deal (9). To determine overall teaching self-efficacy, participants' ratings for each item were averaged to create a unitary construct of teaching self-efficacy.

The TSES has high internal consistency (Cronbach's α is .92; Page et al., 2014). This scale has been administered to a variety of teacher samples in different contexts and has shown evidence of validity and adequate reliability (e.g., Klassen et al., 2009; Moulding et al., 2014; Tschannen-Moran & Woolfolk Hoy, 2001). For example, the TSES has been used to assess differences in self-efficacy across teachers with varying years of experience (Putman, 2012) and has been used to measure teachers' level of efficacy in regards to implementation of new instructional practices (Fives & Buehl, 2009; Wolters & Daugherty, 2007). The TSES has also frequently been used as a measure of teacher efficacy with pre-service teachers (Capa Aydin & Woolfolk Hoy, 2005; Fives & Alexander, 2004; Fives & Buehl, 2009; Knoblauch, 2006; Knoblauch & Woolfolk Hoy, 2008; Larson & Goebel, 2008; Martinez, 2003; Poulou, 2007). More specifically, the measure has been used to detect the trajectory and progress of pre-service teachers as they move through their educational programs towards certification (Gordon & Debus, 2002; Lin et al., 2002; Woolfolk Hoy & Burke Spero, 2005).

Social Validity

Usage Ratings Profile- Web Resource. The URP-WR (Mandracchia & Sims, 2020) was used to measure the usability, feasibility, and acceptability of the web-based teacher training. URP-WR is currently in its initial validation stages, and was developed from the URP-Intervention (URP-IR) rating scale (Briesch, et al., 2013) with the aim to

evaluate the web-based resources intended for teacher education and professional development. Factor analyses during initial validation procedures found that URP-WR was comprised of 4 factors: *Acceptability, Reasonability* (i.e., feasibility and credibility), *Appearance, and Systems Support*. Items from one factor, *Accessibility*, were not used for this study because participants were not independently searching for the training. Consequently, the measure in this study consisted of 27 questions in which participants responded on a 7-point Likert scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). Scores on the URP-WR were computed by calculating a mean score for each of the three included factors in this study.

Procedures

ADHD Webinar Development

Development. Development of this ADHD webinar was guided by findings from current literature and texts (e.g., DSM-5), all of which were cited in each of the lecture videos. This information was corroborated with evidence from the KADDS manual, which includes related citations for each item. This webinar was designed to be a brief, single-session training delivered via webinar. The webinar was accessed through a secure video hosting platform (i.e., unlisted YouTube channel). A school psychology doctoral student delivered the intervention via web-accessible video recordings so that participants could access the web-based training on their own and at their pace. The intervention was developed with the intention to educate preservice teachers on aspects of ADHD, specifically (a) the symptoms and contextual components necessary to diagnose ADHD, (b) the assessment procedures used to verify a diagnosis of ADHD, and (c) the evidence-

based behavioral, cognitive, and educational interventions best used to support students with ADHD. The total length of the web-based intervention was 2 hours; however, participants could pause to take breaks and complete the training at their own pace. The training format included 3 webinars on ADHD: the first webinar focused on the symptoms of ADHD, the subsequent webinar focused on assessment of ADHD-related impairment, and the third webinar focused on evidence-based classroom intervention supports effective for students with ADHD. The training videos included several examples of vignettes that challenge common misconceptions about the disorder. The distribution of contents followed this schedule:

- a. Application of the pre-training survey (i.e., KADDS & TSES)—20 min
- b. Lecture on ADHD Diagnostic Criteria (according to DSM-5; American Psychological Association, 2013), ADHD symptoms presentation at school, and etiology, including presentations of school-based vignettes —30 min
- c. Lecture on standardized assessments used to identify ADHD—20 min
- d. Lecture on available evidence-based behavioral, cognitive, and academic interventions—30 min
- e. Application of the post-training survey (i.e., KADDS & TSES), URP-WR, and demographics questionnaire—20 min

Participant Recruitment

Preservice teachers were recruited using mass departmental emails delivered by the director of the teacher credentialing program in the Graduate School of Education at the University of California-Riverside. Students were also recruited through course

announcements made by professors; some professors also chose to offer extra credit points to students for completing the training. Recruitment materials were provided to professors who then forwarded the recruitment materials to students. The recruitment page provided students a link to the Qualtrics questionnaire with the consent form, if students consented to participate in the study, they were asked to complete the survey via Qualtrics.

Initial ADHD Knowledge and Self-Efficacy Assessment

If pre-service teachers indicated that they would like to participate in this study, (i.e., by signing the virtual consent form delivered via Qualtrics), they were provided directions to continue to the pre-training survey, also in Qualtrics. The pre-training survey required participants to answer each item on the KADDS and TSES measures. The last page of the Qualtrics survey asked participants to enter their email so that the researcher could connect their responses on the pre-training survey to the post-training survey responses. The last page also provided the participants a link to a google document that directed the participants to the webinar delivered via private YouTube videos; both the google document and the YouTube videos could only be accessed if the participants were provided the link.

ADHD Webinar Completion

Participants were provided a link to a document that included explicit directions to access the numbered webinar videos in order: (1) Diagnosis of ADHD, (2) Assessment of ADHD, and (3) Treatment of ADHD. Following these directions were links to each of

the videos provided on the document. To increase ecological validity, the directions on the document informed participants that they may take notes and pause the videos to take breaks as necessary. Following the links to the videos, participants were provided directions to complete the post-training survey. The link to the post-training survey was provided at the end of the document.

Post-Training ADHD Knowledge and Self-Efficacy Assessment

After participants completed the ADHD webinar, participants were instructed to access the link on the document provided to them. This link directed participants to the post-training survey on Qualtrics. The first page of the post-training survey asked participants to provide their email so that the researcher could connect the pre-training survey responses to participants' responses on the post-training survey. The post-training survey included the KADDS, TSES, and URP-WR instruments as well as 10 demographic questions. At the end of the post-training survey, participants were informed they could opt-in to a 6-month follow-up survey if they chose to provide their email.

Analysis

To determine an adequate sample size to address proposed research hypotheses, a power analysis using G*Power (Faul et al., 2007) was conducted. Primary planned analyses included one-way repeated measure analysis of variance (ANOVA). A power analysis indicated that a total sample size of 45 participants would be needed to detect a large effect ($d=0.5$) with 95% power using a matched pairs study design with $\alpha=.05$ (Faul et al., 2007). Therefore, this final sample of 71 pre-service teachers is considered a large

enough sample size to detect power for the analyses described. Once participants received the intervention and completed the post-training measures (i.e., KADDS, TSES), a one-way repeated measure analysis of variance (ANOVA) was performed in R (R Core Team, 2017) to detect whether participants experienced any increases in ADHD knowledge or self-efficacy from pre-training to post-training.

To address the first two study hypotheses that anticipated improved pre-service teacher ADHD knowledge, pre- and post-training survey scores from the KADDS and TSES were assessed using one-way repeated measures ANOVA within subject factor analyses. Descriptive statistics were used to determine whether the data met the assumptions required of a repeated measures ANOVA. The assumptions inherent in a repeated measures design include: (a) the assumption of normality, (b) assumption of absence of outliers, and (c) the non-independence of error assumption (Vogt, 1999). The assumption of normality assumes that the residuals within each group are normally distributed. The normality assumption can be statistically tested using the Shapiro-Wilks test, which compares the scores in the sample to a normally distributed set of scores with the same mean and standard deviation. The Shapiro-Wilks test confirmed scores were normally distributed at each time point ($p > .05$), indicating that the normality assumption was met. Concerning the assumption for absence of outliers, the author considered all observations with standardized residual that lie outside 2 and -2 as outliers. A visual analysis of boxplots (see Supplementary Figures) for each variable were used to identify outliers, no outliers were detected for this data set. Finally, the non-independence of error assumption maintains that error components of each level are associated with other levels

of the independent variable. This assumption is automatically met for repeated measures design because each participant is measured over time (Vogt, 1999). Taken together, all assumptions for the repeated measures ANOVA were met for this data set, results are valid and can be interpreted with confidence.

Unbiased estimates of the effect size (ES) were also computed for the total score from both instruments by calculating η^2 for each ANOVA. As a measure of effect size, η^2 reflects the percentage of variance in the dependent variable explained by the independent variable(s) in a sample. Effect sizes are evaluated using Cohen's (1988) guidelines; consistent with these recommendations, values of .02 or less were interpreted as "small", values .13 -.25 were interpreted as "medium", and values .26 and greater were interpreted as "large" effects.

Results

Knowledge of ADHD

The first research hypothesis anticipated improvements in pre-service teacher knowledge of ADHD symptomology (i.e., identification), diagnostic processes and procedures, and evidence-based intervention practices following participation in this brief, asynchronous ADHD webinar. Significant improvements were anticipated in pre-service teacher KADDS overall scores following completion of a 2-hour ADHD webinar. A one-way repeated measures ANOVA was conducted to compare the main effect of the training on pre-service teacher knowledge of ADHD. A statistically significant difference was noted between mean pre-training scores ($M=24.35$, $SD=3.89$) and mean post-training

scores ($M=14.39$, $SD=8.03$; $F(1, 70) = 121.59$, $p < .001$, $\eta^2 = .39$; see Table 2). These results provide sufficient evidence to reject the null hypothesis, concluding that webinar participation improved pre-service teacher knowledge of ADHD identification and intervention (see Figure 1). Furthermore, unbiased estimates of effect size indicate large training effects ($d = .39$). This suggests that 39% of the variance in KADDS Knowledge scores can be explained by the training.

Table 2

Total Scores on the Knowledge of Attention Deficit Disorder Scale

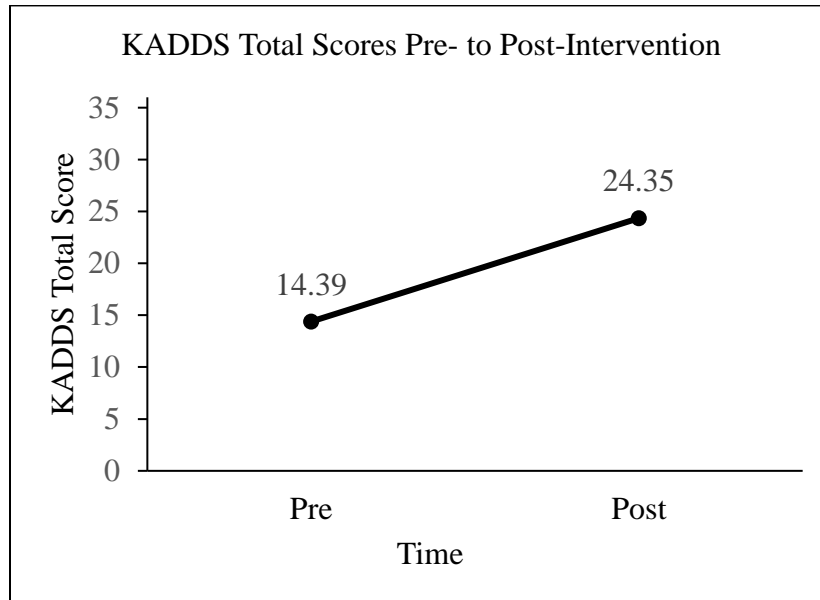
ANOVA Summary

Predictor	Sum of Squares	df	Mean Square	<i>F</i>	η^2
Treatment	3520.06	1	3520.06	121.59***	0.39
Error	2026.44	70	28.95		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 1

The Effect of Training on Participants' Overall Scores on the Knowledge of Attention Deficit Disorder Scale



Note. Knowledge of Attention Deficit Disorder Scale (KADDS)

Educator Misconceptions About ADHD

The second research hypothesis anticipated improvements in pre-service teacher misconceptions of ADHD following participation in this brief, asynchronous webinar. Significant improvements were anticipated in pre-service teacher KADDS scores following completion of a 2-hour ADHD webinar. To evaluate whether the web-based training was effective in refuting pre-service teachers' misconceptions about ADHD, a repeated measures ANOVA was also run using the KADDS misconception scores. There was also sufficient evidence to reject the null hypothesis that the mean number of misconceptions, as measured by the KADDS, exhibited by pre-service teachers were

equal pre- and post- intervention across participants. The repeated measures ANOVA revealed a main effect of time, results indicate that the web-based teacher training had a significant effect on pre-service teachers' misconceptions as measured by the KADDS, $F(1, 70) = 69.36, p < .001, \eta^2 = .22$ (see Table 3). However, misconception scores changed in unexpected directions, where pre-service teachers' KADDS misconceptions score increased by 4.14 points from pre-training ($M=8.37, SD=3.44$; see Figure 2). The effect size for this finding was medium (Cohen, 1988), 22% of the variance in KADDS scores can be explained by the training.

Table 3

Misconception Scores on the Knowledge of Attention Deficit Disorder Scale

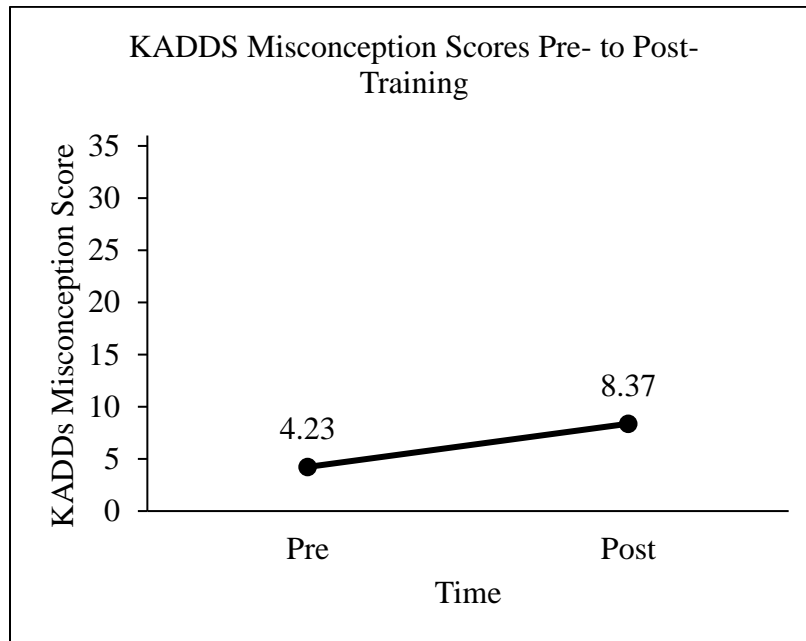
ANOVA summary

Predictor	Sum of Squares	df	Mean Square	<i>F</i>	η^2
Treatment	608.7	1	608.7	69.36***	0.22
Error	614.3	70	8.78		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 2

The Effect of Training on Participants' Misconceptions about ADHD



Note. Knowledge of Attention Deficit Disorder Scale (KADDS)

Pre-Service Teacher Self-Efficacy

The third research hypothesis anticipated increases in pre-service teachers' perceptions of self-efficacy in working with students with ADHD. Significant improvements are anticipated in pre-service teacher TSES scores following completion of a 2-hour ADHD webinar. Results of the analyses assessing pre-service teachers' self-efficacy pre-training versus post-training are depicted in Table 4. There was sufficient evidence to reject the null hypothesis that participants' mean TSES scores before the intervention and participants' mean TSES scores after the intervention were equal. For teachers' self-efficacy, the repeated-measures ANOVA also revealed a main effect of time, $F(1, 70) = 21.76, p < .001, \eta^2 = 0.05$ where, on average, self-efficacy significantly

increased across participating pre-service teachers' following the intervention.

Participants' average self-efficacy increased scores from pre-training (M=6.67, SD=1.36) to post-training (M=7.23, SD=1.20; see Figure 3). The effect size for this finding was small (Cohen, 1988), 5% of the variance in the TSES scores can be explained by the training.

Table 4

Average Scores on the Teacher Self-Efficacy Scale

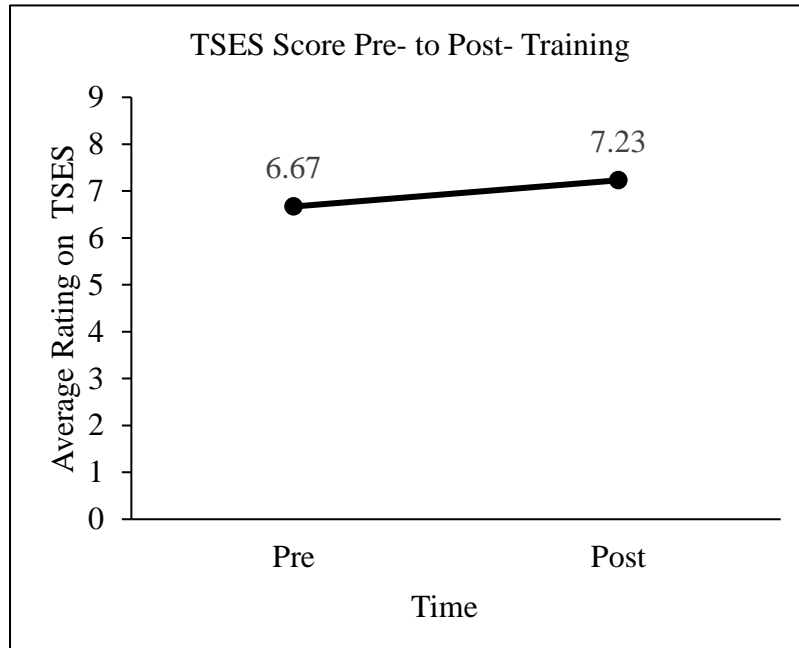
ANOVA summary

Predictor	Sum of Squares	df	Mean Square	<i>F</i>	η^2
Treatment	10.96	1	10.96	21.76***	0.05
Error	35.25	70	.5		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 3

The Effect of Training on Participants' Average Ratings on the Teacher Self-Efficacy Scale



Note. Teacher Self-Efficacy Scale (TSES)

Social Validity

The final research hypothesis anticipated pre-service teachers would rate this intervention as acceptable, bolstering evidence for the social validity of the training. Participant ratings of the usability, feasibility, and acceptability of this webinar will be evidenced by favorable User Rating Profile-Web Resource (URP-WR; Mandracchia & Sims, 2020) scores. All participants' ratings on the URP-WR were aggregated across included domains. Participants generally rated the training as acceptable (see Table 5). On average the *Appearance* score was 54.61 out of a possible 60 (SD=10.95), indicating

that most participants found the PowerPoint slides and pre-recorded videos visually appealing. On average the score for *Systems Support* was 19.63 out of 24 (SD= 5.17), indicating that most participants felt they would need additional support carrying out the recommendations made by this webinar. Finally, the average score for *Reasonability* (i.e., an indicator of credibility and feasibility; see Mandracchia & Sims, 2020) was 71.13 out of 72 (SD=13.16). This *Reasonability* score indicates that most participants believed topics of the webinar were successfully addressed and presented clearly with evidence to substantiate claims, participants would know what to say if they were asked how to implement the recommendations provided by this webinar, and the webinar contained all recommendations needed for implementation of the interventions discussed.

Table 5

Ratings on the User Rating Profile-Web Resource

Source	\bar{x}	s
Systems Supports	19.63	5.17
Appearance	54.61	10.95
Reasonability	71.13	13.16

Discussion

The primary purpose of the current study was to evaluate the effectiveness of a self-paced ADHD teacher training webinar for use with pre-service teachers. Few studies have evaluated the effectiveness of an ADHD training with pre-service teachers and only one study to date has used a web-based format to increase teachers' knowledge about

ADHD (see Corkum et al., 2019). This study used a repeated measures within subject design to compare participants' pre-training ADHD knowledge and self-efficacy when working with students with ADHD and their post-training ADHD knowledge and self-efficacy. Acceptability, usability, and design of the intervention program was further evaluated. In sum, this web-based training was found to be efficacious in increasing pre-service teachers' ADHD knowledge and teaching self-efficacy when working with students with ADHD. However, unexpectedly, misconceptions about ADHD increased post-training. Finally, pre-service teachers' ratings of the web-based training were rated high on reasonability and acceptable ratings were reported for appearance and systems support as measured by the URP-WR.

The first hypothesis for this study maintained that participating in this brief, asynchronous webinar would increase participants' general knowledge of ADHD. Results of this study supported the claim that participants' ADHD knowledge increased post-training. Broadly, findings are consistent with prior related work. Like Aguiar et al. (2014), Corkum et al. (2019), and Latouche & Gascoigne (2019), this brief training resulted in modest improvements in teacher's ADHD knowledge. Importantly, effect sizes in the present study aligned with the findings in previous studies (e.g., Aguiar et al., 2014; Syed & Hussein, 2009), with the exception of Latouche & Gascoigne (2019) whose mean ADHD knowledge gains from pre- to post- training and effect sizes were the highest in the literature so far.

A second hypothesis anticipated improvements in participants' misconceptions about ADHD. Interestingly, misconceptions as measured by the KADDS increased post-

training. Two possible explanations for the surprising increase in misconceptions (i.e., undesired answers) following the intervention. First, the increase may be attributable to participants feeling less inclined to respond that they did not know the answer to a question on the KADDS. This would mean that instead of answering “*Don’t Know*” participants may have answered incorrectly, resulting in an increase in misconceptions post-training. Support for this hypothesis was found after re-examination of the KADDS scores, such that the number of “Don’t Know” responses across all participants decreased from pre-training (\bar{x} = 20.24) to post-training (\bar{x} = 6.2).

A second possible explanation for the increase in misconceptions post-training is that the intervention neglected to review information that would correct participants’ misconceptions, or that the information presented in the webinar was unclear. The author investigated this possibility by first examining which items were incorrectly answered by more than half of participants (i.e., at least 35 participants). Twelve items were identified that fell across all three subscales of the KADDS; however, six of the items belonged to the Associated Features subscale. The author then cross-referenced these items with the material presented during the training. Six of the twelve items were covered in the training (i.e., prevalence, positive illusory bias, medication, and focus of intervention), four items required participants to make a distinction between ADHD and a different neurodevelopmental disability (e.g., Autism), and the remaining two items were not discussed (i.e., child compliance with father versus mother, characteristics of ‘children who come from inadequate or chaotic home environments’). Given this information, future work may improve existing or add to related components of the training; for

example, it may be useful to directly compare the symptoms of students with ADHD and students with Autism so that teachers are capable of distinguishing the students in their classrooms. There are, however, complications with this solution given the high rates of comorbidity of Autism and ADHD in children (Jang et al., 2013). Future research groups might instead choose to correct these misconceptions head on in the pre-recorded videos or using case studies as a frame of reference to guide comparison. This solution might be particularly useful as it could engage teachers in an active discussion on symptoms of ADHD during a live training.

The third study hypothesis anticipated improved perceptions in participant ratings of self-efficacy in supporting students with ADHD. While results of this study supported this hypothesis, the increase in teacher self-efficacy was small. It is possible that the modest increase in ratings of teacher self-efficacy may be attributable to the lack of practical, real-life experience with ADHD described among participants. The modest increase in ratings of teaching self-efficacy could also be explained by the generally limited experiences of pre-service teachers in their program when participating in this study; participants were recruited in introduction to education classes meaning they are relatively new to the teacher education program. These findings align with previous literature evaluating the use of the TSES for pre-service teachers, which has shown that pre-service teachers newer to their credentialing programs are less likely to rate themselves as effective at teaching and that these ratings of self-efficacy may be malleable throughout pre-service teachers' early training years (Duffin et al., 2012). Another potential reason for the small gains in self-efficacy is the lack of modeling and

opportunities to practice included in this training. The self-paced nature of the webinar and time and resource limitations (e.g., brief workshop, single facilitator) did not allow for breakout sessions to practice the skills taught. This limitation is not unlike difficulties described by other brief ADHD training programs (Jones & Chronis-Tuscano, 2008; Latouche & Gascoigne, 2019). Finally, the small but significant gains in teaching self-efficacy may be attributable to the dependent measure used. The TSES is a domain general instrument and may not have been well suited for the specialized nature of the intervention (i.e., ADHD focused). Further, as recommended by Fives & Buehl (2009), this study used a unitary construct of teacher self-efficacy to measure pre-service teachers' self-efficacy. This choice may have the potential to reduce the ability to detect intervention gains using the TSES. Again, these findings align with previous studies that assessed the effectiveness of a training intervention aimed to improve pre-service teachers' knowledge about ADHD (see Latouche & Gascoigne, 2019). Future studies should pay special attention to the nuances of assessing pre-service teacher self-efficacy using the TSES by, for example, examining the factor structure of the TSES using a pre-service teacher sample or by including more specific questions about pre-service teachers' confidence in working with students with ADHD.

The final hypothesis tested maintained that pre-service teachers would rate this intervention as acceptable, bolstering evidence for the social validity of the self-paced, web-based intervention. Results from the URP-WR indicated that overall participants found the Appearance of the training videos and PowerPoint appealing. Participants also rated training as reasonable; the Reasonability factor on the URP-WR encompasses items

related to credibility and feasibility. High ratings on this factor indicate that participants felt the training program cited appropriate and credible sources, was clearly presented, contained all recommendations needed for implementation, and that they understood and could explain the concepts discussed in the training. Average ratings for Systems Support were lower compared to the ratings on the other two subscales of the URP-WR, this subscale comprises items related to the support the pre-service teacher believes they would need from an administrator, co-worker, or other adult. Again, this finding aligns with the current position of these pre-service teachers who are still being trained to carry out the typical skills outlined for teachers and likely do not yet have enough experience to independently carry out the classroom management strategies and other behavioral interventions recommended for use to support students with ADHD.

Limitations and Future Directions

Limitations

While meritorious, it is important to consider the limitations that exist within the current study. First, this study included voluntary participants which dictated the study design employed. Randomized control trials are considered the gold standard in assessing causality (Hariton & Locascio, 2018), unfortunately this study was not able to randomize which participants received and did not receive the intervention due to a combined lack of resources and ethical considerations given that students were offered extra credit for completing the training.

Limitations based on generalizability of findings due to participant demographic characteristics. Participants were early in their pre-service teacher training. Participants

were recruited from introductory education courses and were asked to complete the training for extra credit, which limits the ability to generalize the results of this survey and begs the argument that the pre-service teachers who opted into this study may be more inclined to participate in interventions of this kind. Additionally, many participants were incentivized to participate, which could influence response quality. This is to say, participation may have been less related to a desire to grow professionally and more related to pronounced good or pronounced less desirable dispositional attributes. Some participants may be internally driven to excel in professional growth, achievement (i.e., grades which would be supported by extra credit), or both. These characteristics could predispose participants to improve in response to any training or training format.

The variability in participant timelines may have also confounded results. While participants were given specified times in which to complete activities in absolute, these limits allowed for variability in study completion time. The varying amounts of time participants used to watch the training videos and to complete the post-training survey is an extraneous variable that could not be accounted for in this study given the methods for recruitment. To this point, it may be reasonable to intuit that participants who completed study activities in a more timely manner, particularly the post-KADDS assessment in relation to completing the webinar, may have experienced more pronounced improvements. A strength and potential limitation to the webinar utilized in this study is that the training was self-paced; while this is more generalizable and ultimately more feasible for teachers given their busy schedules, a self-paced training allowed participants to view the pre-recorded videos over varying amounts of time.

Future Directions

The implementation of a randomized control trial to study the effectiveness of this training would allow researchers to control for confounding variables like maturation and timeline for the delivery of the intervention. Future work to explore whether these effects can be replicated with in-service teachers may also be useful for generalization and application in the school setting. Results from an in-service teacher population study might inform administrators' decisions to adopt web-based, self-paced webinars for ADHD as an acceptable form of professional development for teachers.

It is imperative that researchers begin to follow-up on the gains that teachers make in a practical setting well after teachers receive the intervention. One would argue that application of knowledge gained, and adoption of evidence-based practices, is the ultimate goal of the majority of professional development trainings including those that aim to increase teacher knowledge about ADHD. Latouche and Gascoigne (2019), who found that KADDS scores 1 month after the intervention were lower compared to post-intervention but higher than pre-intervention, recommend a follow-up survey at least one-month post-intervention. The clinically meaningful implications that these training programs can have on teachers' interactions with students need to be durable and, therefore, need to be examined after a longer period of time has passed (Bradshaw & Kamal, 2013; Greenway & Rees Edwards, 2020). The author of this study plans to extend these findings by assessing a subgroup of the present sample, namely participants who opted to be sent a 6-month follow-up survey. The 6-month follow-up survey will require participants to complete the KADDS and TSES instruments with the aim to evaluate the

durability of participants' ADHD knowledge and teaching self-efficacy gains acquired from this training.

The majority of pre-service teachers in this sample received no prior ADHD training and few participants reported previously working with a student diagnosed with ADHD. Further, pre-service teachers' knowledge of ADHD as measured by the KADDS was low. The pre-training data from this study demonstrate the need for teacher training programs to educate pre-service teachers on ADHD in order to prepare them for the likely chance that a student with ADHD will be in their classroom (Turnbull et al., 2004). The small but significant improvements in teacher self-efficacy provide preliminary evidence that a brief, self-paced ADHD teacher training delivered virtually may be a viable way of increasing teacher self-efficacy. Actions should be taken on behalf of schools and teacher preparation programs to increase the accessibility of information about ADHD to pre-service teachers.

Future training programs might take preparatory steps like asking pre-service or in-service teachers what they do not yet know and what they believe would be helpful to know about supporting students with ADHD. A useful strategy might be to implement a more interactive question and answer session during the training. A consultative approach where teachers attend an initial training and are then paired with a school psychologist or other qualified professional who consults with the teacher on a regular basis might be useful for increasing teacher self-efficacy. As the teacher becomes more confident and effective in making appropriate decisions and implementing necessary interventions, the consultation intervention could be faded. In a consultative model the teacher would be

able to actively problem-solve with a qualified consultant, and practice using the knowledge and the classroom management strategies learned with reflection and feedback. If a consultative approach was adopted, the inclusion of an instrument that measured teacher and/or student outcomes would help to quantify and clarify whether the intervention made a significant impact on teachers' use of classroom management strategies or an impact on students' behavioral outcomes. Similar consultative work aimed to improve teachers' knowledge, skills, and their beliefs about classroom management may be useful to reference (see Coles et al., 2015).

Implications

This study demonstrated that pre-service teachers' ADHD knowledge and self-efficacy could be significantly improved using this brief, self-paced ADHD webinar. Given the findings that teachers' knowledge of ADHD is limited (Lawrence et al., 2017) and that teaching students with ADHD is more stressful (Greene et al., 2002) this study has important implications for the future training of pre-service teachers. This training has the potential to provide an open access, practical solution to address the well-evidenced gap in teachers' knowledge and training (Guerra et al., 2017; Martinussen et al., 2011; Perold et al., 2010; Sciotto et al., 2016). While this web-based training is not a substitute for comprehensive training in effective classroom management and individual student behavior management, a brief teacher training may be a pivotal and promising first step in helping teachers to better identify and support the behavior of children with ADHD utilizing the wide variety of effective school-based interventions (Corkum et al., 2019; Jones & Chronis-Tuscano, 2008; Latouche & Gascoigne, 2019).

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