Impact of Therapy Dogs on Student Achievement in Rural Math Classrooms

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Abstract

Therapy dogs positively impact students mental and emotional well-being, which can improve the student's academic performance. Therapy dogs can reduce stress and anxiety levels, which leads to better concentration and improved learning outcomes. Canines can also help improve social skills and behavior, which fosters a more productive classroom environment. School accountability becomes more critical each year. Student performance on state assessments determines accountability ratings. This study investigated therapy dogs' impact on academic achievement in a rural middle school math classroom. By addressing this issue through learning motivational theory, the quantitative research sheds light on how incorporating canine animal-assisted interventions into the daily classroom routine can increase student achievement.

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Introduction

The use of therapy dogs received traction in the 1960s through the work of Boris Levinson. In his counseling practice, he noted that when his dog Jingles was present, children opened up and began progressing toward goals (Friesen, 2010; Levinson et al., 2017). Jingles was Levinson's pet, simply a companion dog, revolutionizing how dogs are used in therapeutic settings. Canines gradually appeared in school counseling sessions, then in reading interventions. The literature focuses on reading or counseling; however, a need exists to determine if therapy dogs can positively impact math achievement. The current study found no published literature examining the impact of dogs in math. If canine therapy can positively impact reading achievement, can canine therapy impact math achievement?

Over 2.7 million students take the State of Texas Assessment of Academic Readiness (STAAR) each year. In 2022, 49% of Texas 8th graders did not perform on grade level on the 8th-grade math STAAR test (Texas Education Agency, 2022). In 2019, 69% of 8th-grade students scored basic on the National Assessment of Educational Preparedness Assessment, or the NAEP test (NCES, 2022). There is a problem nationwide in the math performance of 8th-grade students. With school accountability on the line, a need exists to determine if therapy dogs may be an alternative way to impact math student achievement positively.

Problem Statement

The specific problem is the struggle for students to achieve the STAAR's passing standards in middle school math. The researcher sought to determine the impact of therapy dogs on rural student achievement in 8th-grade STAAR math scores at Centerville Independent School District (CISD). CISD is considered a rural-remote school, as classified by the National Center for Education Statistics in 2022. The census defines rural remote as more than 25 miles from an urban center (NECS, 2022). The effects of animal-assisted interventions (AAI) in the math classroom of the eighth grade were evaluated holistically, then assessed by examining gender and socioeconomic status.

Significance of the Study

Research shows a 60% reduction in stress when therapy dogs are present (Anderson et al., 2017). Students perform better on assessments when they feel less stressed (Sadowski & Gulgos, 1995). Bringing therapy dogs into the rural classroom lowers stress and increases student performance on state assessments (Jenkins et al., 2004). Research also suggests that canines can provide students with things teachers cannot, such as a sense of belonging and a nonjudgmental presence (Zents et al., 2017). When students feel at ease and safe, the information they retain significantly improves (López-Cepero, 2020). Schools will receive higher accountability ratings with improved performance on the STAAR, as academic performance accounts for 60% of a school's rating calculations (Lead4ward, 2022). Better accountability ratings lead to designation distinctions, and districts can avoid sanctions by the Texas Education Agency. Positive or improved outcomes in accountability are significant for many reasons.

Purpose of the Study

The current study employed a quantitative approach to determine the impact of therapy dogs on 8th-grade math achievement in a rural middle school classroom. The investigator sought to add a new facet to the existing body of literature regarding the use of canines in education.

Current literature supports the impact of canines on reading and behavior; however, there is limited literature on animal-assisted interventions (AAI) in rural middle school classrooms. There needs to be more literature on the use of therapy dogs in rural math classrooms, and this research will add to the existing body of literature. A three-way repeated measures ANOVA was conducted between gender and then between socioeconomic statuses to determine if the therapy dogs had a more significant impact on males versus females or students in different socioeconomic groups. The results from this study provided more data on the effectiveness (or lack thereof) of therapy dogs in classrooms while providing specific information on the efficacy of 8th-grade math classrooms. This study provided insight into the broader use of therapy dogs in schools, added to the overall literature that describes the impact of AAI in classrooms, and provided specifics of the effects in a math classroom.

Background and Justification

The literature revealed three primary uses of dogs across three areas: counseling, reading interventions, and special education settings. The utilization of canines commonly falls into one of four categories, including animal-assisted therapy (AAT), animal-assisted interventions (AAI), animal-assisted activities (AAA), and animal-assisted education (AAE). For this study, animal-assisted interventions with a therapy dog best supported the goals of CISD.

There are three primary categories for interactions with canines. Animal-assisted therapy uses trained dogs to meet intervention goals (Zents et al., 2017). These animals have been shown to have a positive impact on people in a variety of settings. Mims and Waddell (2016) further specify that AAT reduces isolation, improves self-esteem, and decreases anxiety. AAT is usually part of a goal-directed therapeutic setting in which the dogs meet specific criteria of the healing process (Kropp & Schupp, 2020). Some examples of AAT in school involve using dogs in speech and occupational therapy (Friesen, 2009). Geist (2011) reports that AAT decreased distractibility, improved eye contact, and improved student self-efficacy. Research further supports the benefits of AAT. It lowers the stress of the setting and allows the children to feel a "reduced fear of criticism from a non-judgmental source" (Friesen, 2009, p. 265).

Animal-assisted education (AAE) involves using an animal in an intervention to educate the student on a particular subject (Chitic et al., 2020). The most common type of AAE consists of students reading to dogs in various reading programs. AAEs directed by a general education teacher usually aim to improve reading fluency or comprehension (Kroop & Schupp, 2020). Animal-assisted interventions (AAI) is a broader term encompassing any intervention where humans and animals interact (Lopez-Cepero, 2020). AAI can include components of AAT or AAE. Lopez-Cepero suggests the phrase AAI is most appropriate for activities involving canines because it can be difficult to distinguish between true AAT and AAE. A benefit is provided to a human being regardless; therefore, AAI is more appropriate.

Another all-encompassing term used in the literature is animal-assisted activity (AAA). AAAs "provide opportunities for motivational, educational, recreational, and therapeutic benefits for optimal recovery and functioning, positive development and enhance the quality of life" (Walsh, 2009, p. 470). AAA is much less formal than AAT, as AAT has specific goals toward which the student works. In contrast, AAA is not specific and does not require a certified person to ensure the intervention occurs. Sokal and Kahl (2019) noted that AAA releases oxytocin, the chemical in the brain responsible for happiness and calmness. Schaffer (2009) backed up the claims that AAAs are beneficial because of the emotional, psychological, and physical responses

when humans and animals interact. Within all the animal-assisted types, there are also a variety of dogs. Kropp and Shupp (2020) delineate between a certified therapy dog, an assistance dog, an emotional support dog, and a facility dog. Each dog has a set of parameters or qualifications that must be met to be legally able to meet the needs of its area. Pet Partners (formerly known as The Delta Society), Therapy Dogs International, Intermountain Therapy Animals, and the American Kennel Club are the leaders in providing canine certifications. Animal-assisted therapy has been documented to reduce anxiety; this is also true of students in a special education setting for trauma. Bonding with a dog showed a decrease in depression symptoms and emotional dysregulation. Memory and overall attitude were improved when interacting with the dogs (Maoz et al., 2021).

Research Questions

This study had one primary research question and two sub-research questions. RQ 1 – What impact do therapy dogs have on rural math achievement? Sub RQ1 – What difference is realized in math academic achievement by gender in rural middle schools when therapy dogs are present? Sub RQ2 – What difference is realized in math academic achievement by SES in rural middle schools when therapy dogs are present?

Scope

The scope of this study included students attending Centerville Junior High and enrolled in the eighth-grade math course. CISD is a school classified as rural-remote. This particular focus was selected because the eighth-grade math teacher consistently utilizes a therapy dog in all aspects of her classroom. When measuring the impact of therapy dogs, dogs must be on the class basis routinely. All students taking the STAAR math were examined. Scores were analyzed across the grade level, then by gender and socioeconomic status. The literature is quite detailed on the success of reading programs with therapy dogs. The researcher believed incorporating therapy dogs into math has the potential to have a similar positive impact as reading and could be generalized across school settings if there is fidelity in implementing the therapy dog program.

The subjects for this study were students at Centerville ISD, a rural-remote school in east Texas. CISD covers 260 square miles, where the East Texas post-oak savannah meets the piney woods. Centerville ISD implemented K9U in 2018, which differs from the typical therapy dog program. In K9U, teachers serve as doggie fosters. The puppies usually begin their service at school between 12 and 16 weeks of age (Davis, 2020). The teacher fosters, with the help of students and under the guidance of a trainer, provides the necessary training for the dogs. The canines that graduate from the K9U program are gifted to other schools or veteran homes. Students of all ethnicities, genders, socioeconomic statuses (SES), and learning abilities have equal opportunities to be involved with training therapy dogs. Because CISD is predominantly Caucasian (76%), ethnicity was not selected as a variable for comparison in the data. Instead, the researcher chose gender and SES status as variables for analysis. Delimitations of the study result from the setting.

Literature Review and Theoretical Foundation

According to the National Educational Statistics Center, rural math performance does not meet the level of proficiency determined by the National Assessment for Educational Progress (NAEP) test (NCES Blog Editor, 2019). Proficiency deficiencies in math performance plague rural schools countrywide (Nations Report Card, 2020); Texas is no exception. The federal

education requirements pale compared to the expectations placed on students by the STAAR. Walking the halls of any rural Texas school and the anxiety around testing is intense (Segool et al., 2013). This study aimed to determine the impact of therapy dogs on student math academic achievement in a rural middle school classroom. The researcher examined literature about the current use of canine therapy in schools and the impacts on students' reading, physical stress, brain chemistry, and emotional/behavioral needs. A review of the literature revealed insightful information relating to canines in classrooms. The existence and use of animal-assisted therapies and interventions are vast. It is essential to understand that the canine does not provide therapy. The canine acts as a facilitator to engage students in the desired therapy. The dogs offer emotional support and companionship to individuals across schools, hospitals, and the community (Grové et al., 2021).

Learning motivation theory provided the theoretical foundation for this study. Learning motivation theory can be traced back to Plato and Aristotle. The works of Alkabbi et al. (2017) agree that motivation "is a persuasive feeling that always provides positivism to students to accomplish a task or activity to the end and succeed in it no matter how tough it is" (Gopalan et al., 2017, p.2). The presence of a student in a classroom means something other than the student will or wants to learn. Within the theory of learning motivation, student goals are essential in their desire to learn. Some students need social relationships. In this scenario, students are concerned about peer perception, which can positively or negatively impact student achievement (Seifert & Sutton, 2019).

Human-Animal Interactions (HAI) have been around for centuries. HAIs are reciprocal, dynamic relationships between people and animals. These relationships impact physical and mental health (Hill et al., 2020) and deepen spiritual connections (Newtown Kindness, 2014). To fully understand the depth and historical significance, one must begin with the Native Americans over 30,000 years ago, when the Native American people domesticated wild dogs for companionship (Brodie & Biley, 1999). Mims & Waddell (2016) reveal that dogs have played an integral part in the lives of humans for thousands of years. Under the Chinese zodiac, people are believed to be born with specific characteristics of animals depending on their year (the year of the dog, the year of the dragon) (Walsh, 2009). In Peru, archeologists discovered burial grounds with canines entombed with humans, who wrapped the dogs in blankets with bowls of food and water beside them (Walsh, 2009). Lapdogs were used in Asia in the 1700s to help the human companion and serve as an alarm during the night should an invader attempt to break in (Walsh, 2009).

Furthermore, there is a preponderance of evidence that indicates animals have been used in a therapeutic sense for centuries. In Belgium, as early as the ninth century, there is documentation that animals were used as a therapy for people with disabilities (Morrison, 2007). The York Retreat in England used rabbits, chickens, and other farm animals in 1792. Their primary goal was to enrich the compassion of the emotionally ill (Chitic et al., 2020; Jenkins et al., 2014). In the 1800s, the British began encouraging mental institutions to use animals as a means of helping patients cope (Morrison, 2007). Domestic canines were used in mental institutions as far back as the 18th century—the utilization of dogs in treating chronically ill patients. Dogs help with socialization and those with cognitive impairments (Mims & Waddell, 2016). In 1878, farm animals, specifically horses, were used to treat epilepsy. Military members receiving treatment in the US Army Air Corps Convalescent Hospital found respite and comfort after interacting with animals in 1942 (Morrison, 2007). Perhaps the most famous early adopter

of animal-assisted therapy was Florence Nightingale. She carried small, friendly animals when she nursed patients with various illnesses. The patients experienced comfort and support when the animals assisted Nurse Nightingale on her rounds (Mims & Waddell, 2016). Walsh (2009) concluded that time spent with animals "positively impacts well-being, influences greater health, and decreases recovery time from serious health conditions" (p. 468). A life with improved quality and enhanced communication is attributed to the joy humans receive from canines (Jenkins et al., 2014). In the 1960s, Boris Levinson discovered that his dog, Jingles, helped his patients during therapy sessions. Dr. Levinson referred to Jingles as the social lubricant that assisted his patients to be more relaxed, thus able to make progress in the therapy sessions (le Roux et al., 2014; Walsh, 2009). The relationships forged between humans and canines have occurred for centuries and deserve further examination.

Types of Dogs

Within the animal-assisted community, several types of dogs exist. Before dogs can begin training, the canines must be tested. Evaluation of puppies includes temperament testing and their willingness to walk across varied surfaces (grates, tile, concrete, grass.). The social side of the dog is also appraised. Dogs must desire to engage with others and demonstrate confidence in new settings yet remain calm and steadfast (Davis, 2020). Basic commands for therapy dogs include sitting, staying, dropping, walking, heeling, and going home (Hill et al., 2020). The Delta Society encourages canines and handlers to be trained for specific environments (Geist, 2011).

Facility dogs are a constant in residential and clinical settings, such as assisted living facilities, veteran homes, or hospitals. The facility dog lives with the handler, an employee of the facility. The dog goes to work with the employee and provides an assortment of animal-assisted activities, interventions, or therapies (Kropp & Shupp, 2017). These facility dogs receive training specific to the environment they will serve to ensure the *fit* will be successful (Davis, 2022).

Emotional Support Animals (ESA) include dogs that help support people with emotional difficulties. ESA support includes anxiety, depression, and phobias (Service Dog Express, 2018). Krupp and Schupp (2017) insist that a mental health professional must prescribe emotional support dogs. Emotional support dogs are guaranteed other public access than service dogs. Service dogs are trained to help people with a disability and are considered working dogs (Walsh, 2009). Service dogs are permitted under the Americans with Disabilities Act and are legally classified (Mims & Waddell, 2016). Service dogs are specially trained to perform tasks to enhance the lives of their handlers. Examples include serving as a brace for people struggling with mobility, as *eyes* for a person with blindness, and as opening doors for people who cannot. The critical feature of service dogs is that the dog must perform a service for a disability. While the vests worn by emotional support and service dogs are similar, their functions differ vastly (Davis, 2022).

Therapy dogs are classified as working dogs. Working dogs are trained to perform tasks designated for the type of job the dog will perform. Therapy dogs work with groups and individuals in various settings to provide therapeutic relief (Chandler, 2001). Therapy and service dogs are not interchangeable, as each type serves different functions (Mims & Waddell, 2016). Dogs do not have to be a specific breed to qualify as therapy dogs. A therapy dog must have a temperament and obedience level that will allow them to obtain the Canine Good Citizen certification. The Canine Good Citizen distinction means the dog has proven an even temperament and is well-mannered in all settings. The Canine Good Citizen ensures that dogs

are calm in all environments (Callahan, 2017). In an educational setting, therapy dogs are used to help calm students, teach empathy, improve self-confidence, improve social skills, help positive psychological development, improve communication abilities, provide friendship, teach responsibility, foster independence, and improve overall attitudes toward school (Callahan, 2017; Friesen, 2010; Newtown Kindness, 2014).

Friesen (2009) noted that anecdotes relating to therapy dogs in an educational setting are becoming more frequent as new programs are launched to meet the ever-growing needs of students. The utilization of dogs by teachers and principals is increasing. Schools use dogs to increase student psychological development, improve confidence, teach empathy, relieve stress, improve communication, and improve social skills. Traditional avenues cannot duplicate the sense of calm therapy dogs provide (Newtown Kindness, 2014; Callahan, 2017). Pechacek (2020) describes the immense benefit dogs offer to middle school students. Middle school students taught the dogs tricks, learned to feed and water the dogs properly, and how to approach animals. All of these steps led to a demonstrated increase in self-responsibility for middle school students. Furthermore, the effects of these activities on children have been empirically supported (Jenkins et al., 2014). The belief behind the success lies in the attachment bond children develop with the animals. Humans have an innate desire to form an attachment bond with other humans. Research suggests that dogs can fill the same role as humans in attachment, thus providing children with a sense of stability (Sokal & Kahl, 2019). Understanding the individual's needs when determining the type of dog is essential for success and positive outcomes for the handler and the dog. Payne et al. (2015) inform that the canine ability to understand and respond to humans far surpasses the capacity of other mammals. The handler and the canine relationship are emotional, from working with livestock to security to public access assistance. The emotional capacity of our four-legged friends makes them ideal for therapy and school involvement (Payne et al., 2015).

The Brain

Before understanding how canines help with interventions and behaviors, it is crucial to understand what happens in the brain when a person pets a dog. Walsh (2009) stated that petting animals release neurochemicals in the brain, resulting in relaxation and bonding. Simply put, oxytocin is released in the human brain when a dog is touched. Oxytocin is one of the four *feel-good* hormones. These hormones help people feel happy, calm, and at peace (Sokal & Kahl, 2019). There are indications that the human/dog bond is mutually beneficial in releasing oxytocin, and the human receives the benefit of having their mood improve (Levinson et al., 2017). Oxytocin is produced in the hypothalamus and released by the pituitary gland as part of the brain's limbic area and endocrine control. This area of the brain is responsible for how we develop relationships and attach to others, helps create memories, and controls the release of feel-good and stress hormones (Payne, 2018). The brain's right hemisphere is closely connected to the limbic region, where human attachment develops. These brain areas are central to processing human emotion (Geist, 2011).

Cortisol is released when stress is sensed, putting the entire body on edge (Callahan, 2017; Payne, 2018). Research indicates that simply stroking the dog's fur reduces cortisol levels. Seven to twelve-year-old boys responded better in a stressful situation with a dog beside them than a friend (Beetz et al., 2011; le Roux et al., 2014). In 2012 Beetz et al. conducted a study to measure cortisol levels in children. These measurements occurred pre/post a stressful situation. Cortisol levels were noticeably lower when the children interacted with a dog during the stress.

The article further stated, “The presence of a dog in an educational setting would help reduce anxiety levels caused by pressures existing in the classroom” (p. 7). When oxytocin is produced in the brain, cortisol cannot be synthesized in the body, resulting in children feeling at ease (Beetz et al., 2012) and reduced signs of depression (Pechacek, 2020). Another impact noted in the literature is reducing a patient's blood pressure when reading to dogs. Cortisol causes blood pressure to increase. They read aloud to the canine to reduce blood pressure because of the connection to oxytocin and cortisol (le Roux et al., 2014). The recommendation for maximizing the benefit of reducing cortisol is to pet the dog as it aids in lowering pressure. Along with a decrease in blood pressure, reading to a dog decreases heart rate, anxiety, depression, and fear (Lane & Zavada, 2013; Pechacek, 2020; Zents et al., 2016).

Emotional and Behavior Support

A growing body of literature supports canines to support students' emotional and behavioral needs. Canine therapy provides numerous benefits, from helping regulate behaviors, increasing positive social interactions, and assisting a student's emotional state. The literature suggests that behaviors improve, and emotions stabilize because the dog is not afraid of being judged. When students feel out of place, there is a notable increase in the student’s stress level, leading to more absences and poor academic performance (le Roux et al., 2014; Stevenson et al., 2015). Like best friends, dogs proved to be great listeners, provide physical comfort, and demonstrate empathy (Geist, 2011; Von Lintel & Bruneau, 2014). This warmth of the dogs allowed children to exhibit more social interactions because dogs serve as enablers of social interactions (Kirnan et al., 2018; Wilson, 2017). As children became more comfortable in social situations, researchers saw an increase in positive emotions and behaviors and a decrease in anxiety, depression, and other behavior issues (Kropp & Shupp, 2017; López-Cepero, 2020b). While dogs cannot heal from all traumatic experiences, canines can provide a sense of safety that can start the healing process (Kropp & Shupp, 2017).

Pechacek (2020) found a calming effect on students after the therapy session. The study further noted that hyperactive students were more responsive to classroom instruction after spending time with a dog. Therapy sessions involve teaching students how to groom and feed the dog. Careful attention to ensuring students know how to approach animals safely emphasizes that safety is essential (Brodie & Biley, 1999). Students with less social support demonstrate more significant responses to AAT (Ward-Griffin et al., 2018). Students who struggle to converse often do not struggle to talk to a canine. Dogs are part of a reciprocal conversation social skills lesson to help students gain confidence in casual conversations. Not only does conversation improve, but social behaviors also demonstrate enhancement. Students show more positive peer relationships after spending time with a therapy dog. Anxious students calm down in the presence of a dog because the canine helps regulate emotions. Time with canines helps children learn sympathy, perseverance, and determination (Brodie & Biley, 1999; Friesen, 2010; Ward-Griffin et al., 2018). Therapy dogs have positive impacts on behavior and emotional regulation. AAT increases motivation, leading to more on-task behavior and positive social interactions (Bassette & Taber-Doughty, 2016; Jenkins et al., 2014; Kirnan et al., 2020; Von Lintel & Bruneau, 2014).

In practice, AAT takes on many forms. One school provided a dog in the classroom that helped increase emotional well-being and overall attitude toward academics. The dog taught the students about empathy and respect (Beetz et al., 2012; Chitic et al., 2020; Kropp & Shupp, 2017; Von Lintel & Bruneau, 2014). Students demonstrated less aggressive and off-task

behaviors and listened to the teacher better with a canine present. Teachers documented improved student motivation and on-task behavior after sessions with a therapy dog (Jenkins et al., 2014; le Roux et al., 2014). Zents et al. (2016) noted: "less negative comments between students, increased use of praise, decreased distractibility, improved relationships, eye control, more appropriate voice or tone with others, decreased tantrums, and decreased learned helplessness" (p. 88). The results ultimately led to more autonomy and empathy with the student body (Zents et al., 2016).

Special Education Settings

Animal-assisted interventions provide many benefits in a special education setting, with students with autism and behavioral difficulties the most documented. Autism spectrum disorder (ASD) is a family of neurodevelopmental disabilities characterized by difficulties in socialization and communication. Students with ASD exhibit restrictive and repetitive behaviors and stereotyped behavior patterns, interests, and activities (Hill et al., 2020; Stevenson et al., 2015). ASD manifests differently in each child; however, engaging with others is a common difficulty among many. AAT provides an approach for students to experience positive engagement with others (Fung, 2016; le Roux et al., 2014; Stevenson et al., 2015). In a randomized control study, animal-assisted therapy with canines allowed students on the spectrum to achieve more time on task, meeting more goals than traditional goal-directed therapies (Hill et al., 2020).

A study reported that AAT helps improve social and communication skills (Chitic et al., 2020). Counseling sessions with dogs document increased communication and positive relationships with others (teachers and peers). The improved abilities transfer to the home and parents report an increased quality of life (Zents et al., 2016). Dogs in therapy sessions for children with ASD increased the student motivation to participate, resulting in better communication and increased social interaction. Non-verbal children with high sensory needs enjoy AAT. The dog provides tactile stimulation while providing a calming effect. Teachers report rocking and other stemming behaviors from autism decline significantly after a session of AAT (Pechacek, 2020). Another benefit canines have on children on the spectrum is the ability of the dog to help the child become less socially withdrawn and minimize repetitive behaviors. Using canines in all aspects of the education of students with autism could provide an avenue for students to achieve goals and increase social interactions (Stevenson et al., 2015).

Students with emotional or behavior disorders (EBD) is another group of students that benefit from AAT in the special education setting. This particular population of students has unique classroom management needs. Students identified as EBD are often off task, aggressive, disruptive, and will not obey basic classroom rules. AAT used with students with EBD documented a pattern of increases in positive behaviors and compliance with teachers and parents (Kirnan et al., 2018). Canines provide a calming effect, allowing for more positive social interactions and relationships with teachers (Friesen, 2010; Kirnan et al., 2018). Specific behaviors include positively initiating interactions, using appropriate voice volume and tone, making eye contact, and smiling. Students appeared less nervous and had fewer behavioral outbursts with the dog. Students improved on-task academic and overall behavior (Kirnan et al., 2018).

Student motivation is a commonly documented need for students identified as EBD (Bassette & Taber-Doughty, 2016; Friesen, 2010; Kirnan et al., 2018; Wilson, 2017). After sessions with a therapy dog, students felt better about their behavior and ability to perform

academically. Students began to advocate for themselves positively and demonstrated improved attitudes toward school. Teachers noted a decline in negative behaviors and an increase in positive behaviors after the dog visited. Students with EBD discussed their time with dogs in AAT. The students overwhelmingly identified more motivation, better ability to complete academic tasks, and improved self-confidence due to AAT (Kirnan et al., 2020).

Middle school teachers working with students with EBD identified increased reading difficulties in this population. Due to motivation, the reading difficulty creates more behavior problems for the student and the teacher. The nonjudgmental nature of canines provides a safe place for students to practice reading via AAI. After AAI, students self-report feeling calmer, less anxious, and more confident in their reading abilities. Furthermore, the presence of a therapy dog helped teach empathy, foster responsibility and encourage respect. Middle school teachers reported that AAI improved students' motivation and overall behaviors with EBD (Bassette & Taber-Doughty, 2016).

Concerns

The documented positive impacts of AAI are overwhelming. However, there are concerns with AAI that must be addressed. Canine vaccines are the primary concern mentioned. Other considerations include the children's handwashing before and after handling the dogs and protecting the safety of the dog and the children (Friesen, 2010; Kropp & Shupp, 2017). Ensuring children know how to approach dogs properly takes time, which can be a limiting factor during a school day (Friesen, 2010). The dog's sanitation, allergy, and ethical considerations must be addressed before implementing an AAT (Friesen, 2010; Zents et al., 2016). Safety concerns for the dogs also exist. The handler must be trained to recognize signs of distress in the dog. Signs include the ears laid back, shaking, tail between legs, or excessive licking (Friesen, 2010). Obtaining the American Kennel Club Canine Good Citizen certificate encourages the best practices of properly trained handlers (Levinson et al., 2017). The AKC Canine Good Citizen ensures that the dog is well-mannered, another concern mentioned in the literature (Fung, 2016). An excellent canine handler will have liability insurance to quell the fears of those with poor attitudes toward dogs (Lane & Zavada, 2013; Sokal & Kahl, 2019). Specifically related to schools, the expense and the time of training a dog can be overwhelming. School personnel who choose to be canine handlers need total administrative support, the right dog, clear school guidelines, and cooperative parents. Aligning the variables is challenging; however, a dedicated handler must know the potential roadblocks (Callahan, 2017; Friesen, 2010; Zents et al., 2016).

Method

The Every Student Succeeds Act (ESSA) dictates that students must complete annual statewide testing in math during grades 3-8 (U.S. Department of Education, 2015). In the state of Texas, school accountability equals high stakes. School accountability ratings are based on domain ratings in academic performance, student growth on state assessments, attendance, closing the gap, and college, career, and military readiness (Lead4ward, 2022). The Texas School Accountability system rates schools on a letter scale of A-F. Anything lower than a C on school accountability results in sanctions by the Texas Education Agency (TEA). A Targeted Improvement Plan is the first line of sanctions across the board. Writing a Targeted Improvement Plan is a long, arduous process that involves a committee, multiple meetings, and a professional

school service provider that serves as the liaison between the district and the Texas Education Agency.

Over the last ten years, Centerville Independent School District (CISD) has written multiple Targeted Intervention Plans for a campus not rating high enough or having a letter of D in one of the three domains. CISD has also written Equity Plans. Equity Plans are state-mandated plans to address how the district will decrease gaps related to low-income students and students of color who are being taught at higher rates than other students by inexperienced, out-of-field, and ineffective teachers. This sanction is implemented because the domain on closing the gap did not meet the minimum score determined by the Texas Education Agency. Closing the gap measures up to fourteen student subpopulations and compares them to forty other districts with similar demographics. District scores falling below the state-determined mark in the closing the gaps domain result in an Equity Plan to show how the district will ensure that education is equitable across all student populations. CISD decided to address student achievement unorthodoxly and started K9U.

Research Questions and Hypotheses

Research Question 1 (RQ1) – What impact do therapy dogs have on rural math achievement?

Ho = There is no impact on student math achievement in rural classrooms where AAI was used.

Sub Research Question 1 (Sub RQ1) – What difference is realized in math academic achievement by gender in rural middle schools when therapy dogs are present?

Ho = There is no impact on math achievement by gender in rural classrooms where animal-assisted interventions were used.

Sub Research Question 2 (Sub RQ2) – What difference is realized in math academic achievement by socioeconomic status in rural middle schools when therapy dogs are present?

Ho = There is no impact on math achievement by socioeconomic status in rural classrooms where AAI was used.

The proposed research study is unique because the researcher could not find a single study using therapy dogs in a math classroom. Furthermore, every study identified included using therapy dogs to provide reading, emotional, or behavioral support. CISD used students to help train the dog, creating a higher level of engagement among student participants.

Research Design

Descriptive research focuses on the *what* of a subject rather than the *why* (Manjunatha, 2019). Creswell (2011) states, "The basic intent of an experimental design is to test the impact of a treatment (or an intervention) on an outcome" (p. 137). This exploratory, descriptive research seeks to determine what impact therapy dogs have on math academic achievement and employs an interventional approach. In this study, canine therapy was the intervention between the pre/post-test. Criswell further identified four critical characteristics of exploratory research: participants, materials, procedures, and measures. The rationale for this study came to be because there is a significant body of research on using canines to assist in reading. The researcher located no information regarding the use of canine therapy in math classrooms. The scores from state

assessments were the metric for measurement. The researcher did not influence the behaviors of the subjects. The study analyzed the group (all 8th grade) and examined scores categorized by gender and socioeconomic status. This study was centered on one primary research question, two sub-research questions, and research hypotheses.

Setting

This study occurred in a rural junior high in Texas. The school district is located in the city that serves as the county seat. There is no industry to support the tax base in the district, and the school is a Title I district. A Title I school has many students identified as having low socioeconomic status, meaning those students qualify for free and reduced lunch. In Texas, schools with 40% or more low socioeconomic students receive the Title I designation. In the school district in the current study, 77% of the student population is Caucasian, 12% Hispanic, and 11% African American. The K9U program began in CISD in the fall of 2017 as district leadership sought to reach students through non-traditional means. In the spring of 2016, 45% of the district's 8th graders passed the STAAR math assessment, compared to 81% passing the STAAR reading assessment (Texas Education Agency, 2016). The passing percentage in math, based on preliminary data from the district, Texas Education Agency (TEA) data, and the information provided by the NAEP, clearly indicated that change must occur. CISD tried multiple means of addressing the issue, and CISD did not see the growth necessary to keep TEA sanctions at bay. At that point, CISD decided that something radically different must occur.

District leadership researched options, and the campus was already doing the most recommended interventions (Istation, StemScopes, and a master teacher). The curriculum director read an article highlighting therapy dogs' impact on reading achievement. The article read by the curriculum director article led to the creation of K9U. The school district partnered with a local, reputable breeder that already had a trainer on staff. Together, these organizations spent the 2016-2017 school year drafting what the K9U program would look like, how it would operate, and outlining key goals. In the fall of 2017, four teachers agreed to foster therapy dogs and train the dogs by incorporating them into daily classroom activities. Most foster dogs stay in place for one semester. Many teachers realized the commitment was steep and opted to foster for only one semester during the school year, leaving the 8th-grade math teacher as the lone participant having a canine in the classroom all year. STAAR math scores in the spring of 2018 rose to 71%, spurring the district to ensure a canine was available in the classroom as much as possible.

Additional Study Information

The goal of this research study was to determine if therapy dogs have an impact on math achievement in rural students at CISD. This descriptive study utilized quantitative methods. Pre and post-canine intervention scores were examined to determine the impact therapy dogs had on students in a rural middle school math classroom. Creswell (2011) states that pre and post-testing was an acceptable method of obtaining statistical data. The State of Texas Assessment of Academic Readiness (STAAR) is given to students across Texas each spring. The STAAR test is the Texas version of the ESSA annually mandated tests for reading and math in grades 3-8. The STAAR comprised questions based on each course's student learning expectations (Texas Essential Knowledge and Skills, TEKS). Students who pass the STAAR are considered proficient in grade-level content. Students failing the STAAR are considered not proficient. Texas school accountability ratings are based on how well the students perform on the STAAR

test. Failing STAAR scores will equate to a poor letter grade in accountability. Schools strive to obtain a letter grade of A, B, or C to avoid the sanctions the Texas Education Agency mandate. This study compared the percentage of questions correct (math scores) from the 7th-grade STAAR math assessment to scores obtained in 8th grade. More questions correct on the state assessment equates to a higher percentage score, especially since the 7th and 8th-grade tests have the same number of questions. There may be an expectation of natural growth between 7th and 8th grade; therefore, the researcher used a control group. The control group was one period when the dog was off-duty and not in the classroom.

In this quantitative study, the researcher used descriptive and ANOVA (analysis of variance) analysis to draw precise conclusions about the research questions and hypotheses. A repeated measures ANOVA is a type of analysis of variance (ANOVA) in which the same subjects are used in all conditions or groups being compared. It is a within-subjects design in which the same subjects participate in each condition or group (Buidiu, 2018). A repeated measures ANOVA was implemented to determine whether a significant difference existed between the means of the groups being compared. It also decided whether the difference was due to the treatment or the condition applied to the subjects.

STAAR is administered each spring to students in grades 3-8 in reading and math. The participants were selected based on convenience because the 8th-grade math teacher consistently had a K9U-selected and trained dog in her room. The study participants were all 8th-grade students enrolled in her math course. The only caveat was that participants for this study had to have taken the 7th-grade STAAR math test at CISD. The targeted audience for this study had no canine exposure in 7th-grade classes. However, in 8th grade, the targeted students will have played a critical role in training and helping develop a therapy dog. Canine tasks and training were built into every facet of the classroom, from taking the dog outside between classes to teaching the dog obedience and tricks. Every student (that took STAAR math in 7th and 8th grade) was included to ensure an adequate sample size. Data were coded by gender and socioeconomic status to address the sub-research questions. The canine in the classroom was the one significant variable from 7th to 8th-grade math. Using the STAAR test results, the researcher believed the study's outcome would impact the therapy dog's use. The use of a control group further supported this hypothesis. The control group was the entire population of the one period when the dog would not work; instead, the therapy dog rested in a crate in the classroom (best practices for canine health).

Instrumentation

The instrument for this study was the math portion of the STAAR for the 7th and 8th grades. In 2012, the Texas Education Agency changed the required standardized assessment to STAAR. The STAAR is the latest product of testing that began in Texas in 1979. The curriculum for the test is derived from the Texas Essential Knowledge and Skills (TEKS). TEKS replaced Essential Elements in 1998-1999 and focused more on student knowledge and teacher performance. The TEKS are revised, with considerations made by public comment every seven years (Texas Education Agency, 2012).

In 2016, the Texas Education Agency outsourced an evaluation of the reliability and validity of the STAAR assessments, specifically reading and math, in grades 3-8. The sixty-nine-page report, completed by Human Resources Research Organization, detailed the findings of the three-prong task. Deatz (2016) determined that “the vast majority of items were aligned with the

TEKS expectations" (p. 58). Furthermore, Deatz and his team provided empirical evidence of the reliability of the assessment and standard error of measurement. A review of the STAAR's test construction and scoring methods was consistent with industry standards and supported the claim that the STAAR assessment measures the knowledge and skills outlined in the TEKS. Evaluating the reliability and validity of the STAAR assessment provided confidence to the researcher that the study's results would be accurate. This measure was the best fit for this study because it is given across Texas and the ease with which assessment results were available to the researcher. Every public school in Texas is familiar with the STAAR assessment, and states across the union must give their version of this summative assessment to meet the requirements outlined in the ESSA.

Data Collection and Analysis

Data collection occurred after the data had been released to the district by the Texas Education Agency. The data for the analysis were pulled from the school district's data platform, Eduphoria, and then entered into SPSS for the data analysis. Data for the research question and each sub-research question were analyzed and compared to the control group to determine the score difference in each area. A three-way repeated measured ANOVA test was utilized to compare data pre and post-intervention. An increase in scores would indicate that the canine intervention was effective. No significant change in scores would indicate that the canine did not have an effect. The dependent variable was the test scores. The therapy dog intervention was the independent variable.

Intervention

In pursuing this study, the researcher wanted to quantify therapy dogs' impact on math academic achievement by measuring the passing rate on STAAR math tests from 7th to 8th grade. The straightest line to this information was the data from the STAAR test administered each spring in grades 3-8. Using scores from students who took the STAAR math assessment in 7th and 8th grade at CISD, a statistical comparison determined the impact of therapy dogs on achievement. The analysis utilized the 7th-grade assessment as the pre-test. The 8th-grade test served as the post-test. The intervention was the therapy dog in the math classroom for 8th grade.

The intervention for this pre and post-test study was in the form of a therapy dog in training. After a puppy undergoes temperament testing, the canine is assigned to teacher fosters at CISD. The teacher worked to make the dog part of every aspect of the classroom. For example, the student completes the bell ringer activity and can give the dog a goldfish cracker treat, given that the dog follows the command (sit, stay, down, heel, home). Students were given *jobs* to assist in housekeeping. Jobs included walking the dog, feeding/watering the dog, taking the dog to visit another class, or sending the dog home (to the crate) to rest. Access to the therapy dog was tied to attendance, tardies, or desired behaviors for students that needed extra support. For example, if Janie came to class every day this week, she held the therapy dog during the lecture on Friday. If Timmy gets to class on time, he can take the puppy outside at the end of the period. Therapy dogs ensured that every aspect of a student's social and emotional needs was met. One of the ways dogs helped was by the dog having opportunities to shop. Shopping is when a canine walks up and down the aisle or around the room and alerts someone. Often, the alert is a student that needs extra attention and has needs not visible to the teacher. This process encouraged

students and provided a much-needed cortisol boost during class. Shopping was where many of the strongest canine/student bonds were formed (Davis, 2022).

Threats to Internal Validity

Threats to internal validity include history and maturation (Adams & Lawrence, 2019). Kelce (2017) states that tremendous growth and maturation occur between the 7th and 8th grades. As eighth graders, students felt more confident and at ease with the school year. Confidence in the location of courses, expectations, and more freedom to move across campus are a few reasons for improved confidence in 8th grade. The pre-teen moodiness noted in 7th graders has dissipated notably by 8th grade. Combined with the improved academic response, these biological maturation factors could threaten internal validity. The researcher expected validity to remain intact for the study by utilizing the entire grade. History is another consideration when discussing internal validity. Because this study involved humans and canines, this researcher could not be sure that history over one year would not be an influence one way or another. Canine's bond with humans to different degrees of closeness (Barber & Proops, 2019). It is impossible to infer the closeness of a canine to any given group of students. The teacher has been a crucial part of K9U since its inception; therefore, the researcher anticipated that the teacher would be able to help negate any history that would risk the study's internal validity.

External Validity

External validity is the extent to which study findings can be skilled across settings, people, situations, and measures (Bhandari, 2020). Threats to external validity include selection bias, history, experimenter effect, testing effect, aptitude treatment, and situation effect. This experiment involved pre and post-test data, and students did not know they were part of the experiment; therefore, the testing effect and situation effect were the external validity concerns in this setting. The testing effect occurs when subjects are tested more than once, skewing the results. Students took each test only one time, as required by law. The situational effect refers to the fact that students are assessed in classrooms with which they are familiar. The canine visited each testing room to ensure students felt loved and reassured. Students are familiar with their testing environment, and the researcher did not anticipate any complications with external validity.

STAAR testing was the measure, making replicating this outside of Texas hard. However, this study should be reproducible in any school with a vetted therapy dog program. An enormous body of literature cites the success of canine therapy programs on student reading. While the approach differed for this study, the impact of canines on academics is documented. The researcher does not recommend that schools replicate CISD's K9U program without the supervision of a reputable dog trainer and breeder. A canine's temperament can make a K9U experience successful or not. An ill-tempered dog will not learn commands as fast or be a good fit for children. Therapy dogs, especially those used in a school setting, must be mild-tempered, with a drive to please (Davis, 2022).

Ethical Procedures

The data were analyzed using Statistical Product and Service Solutions (SPSS) software. For the RQ and sub-RQs one and two, a repeated measures ANOVA was performed between all students for RQ1. Sub-RQ1 examined the differences between gender, and sub-RQ2 between socioeconomic statuses. Research indicated that boys and students from low socioeconomic

backgrounds struggle more academically than their peers (Beetz et al., 2012; Payne, 2018). This test was appropriate when determining the effect of an intervention on pre/post-test scores. The descriptive statistics include the mean pre/post as a grade level, mean difference, p-value, standard deviation, confidence interval, effect size, and degrees of freedom.

Potential Research Bias

The researcher has served as a canine foster and has been involved in training therapy dogs since K9U began in 2017. Watching the growth of the canines and students is inexplicable. Having a front seat, the researcher has numerous positive narratives about how a therapy dog brought a student out of their shell, motivated them, helped them learn multiplication facts, and improved student attendance. However, these anecdotes are not numbers and are difficult to quantify, thus the decision to conduct this study. The researcher could quantify with data any impact therapy dogs may have on student achievement using an instrument that would provide data that could be measured, such as the STAAR assessment.

Results

This quantitative study aimed to determine therapy dogs' impact on academic achievement in a rural math classroom. The STAAR measured academic achievement, the summative evaluation given to every student in grades 3-10 in reading and math at the end of every academic school year. Research participants included 7th and 8th graders enrolled in and taking STAAR assessments at Centerville ISD for both grade levels and were selected to provide numerical statistics for the effectiveness of the canine intervention. The results of this study provided insight as to whether canine therapy is a potential way to impact math achievement. The data were assembled from the STAAR in math class at the end of the 7th and 8th-grade years. The researcher used a randomized experimental design to answer the questions. This random assignment method helps to ensure that any differences between the two groups are due to the intervention rather than any other factor.

Description of the Sample

A sample of 123 students in rural classrooms participated in the study. These students were divided into a control group and an intervention group that received therapy dogs (AAI). Twenty-two students participated in the control group, and 101 students participated in the AAI group, as noted in Table 1 below.

Table 1

Therapy Dog Intervention Participation Numbers

	Frequency	Percent	Valid Percent	Cumulative Percent
Control	22	17.9	17.9	17.9
AAI	101	82.1	82.1	82.1
Total	123	100	100	100

Table 2 shows that the control group consisted of 7 females and 15 males, with 10 being economically disadvantaged and 12 being non-economically disadvantaged. The AAI group comprised 39 females and 62 males, 45 economically disadvantaged and 56 non-economically disadvantaged. The math scores of the participants were measured at grade 7 and grade 8, and a three-way mixed repeated measures ANOVA was conducted to examine the main and interaction effects of gender, economic status, and therapy dog intervention on math scores. The statistical analysis was performed using IBM SPSS V.27 software.

Table 2

Number of Participants in the Control and AAI Groups by Gender and Economic Status

		Female		Male	
		Non-EcoDis	Eco. Dis	Non-Eco. Dis	Eco. Dis
Groups	Control	5	2	7	8
	AAI	22	17	34	28

A three-way mixed ANOVA was conducted to examine whether there was an effect of students' gender (male and female) and their economic status (economically disadvantaged and non-economically disadvantaged) by therapy dogs intervention groups (Control and AAI) on student math achievement in rural classrooms. RQ 1 was evaluated, what impact do therapy dogs have on rural math achievement? The Tests of Within-Subjects Effects results showed a significant main effect of grade on math scores, $F(1, 115) = 38.77$, $p < .001$, $\eta^2 = .25$, indicating that math scores significantly raised from 7th grade to 8th grade, not controlling for other factors.

The results of the Tests of Between-Subjects Effects showed a significant main effect of group on math scores, $F(1, 115) = 7.70$, $p = .006$, $\eta^2 = .06$, indicating that the therapy dogs (AAI) intervention group (M=55.78, SE=1.43) had significantly higher math score differences compared to the control group (M=45.48, SE=3.42), as shown in Figure 1. The mean average increased by 14 points from 7th to 8th grade. This conclusion supports the hypothesis that there is a significant impact on student math achievement in rural classrooms where AAI is used.

Next was the evaluation of sub-RQ1, which asked what difference is realized in math academic achievement by gender in rural middle schools when a therapy dog is present. There was also a significant interaction effect of group and gender on math scores, $F(1, 115) = 6.79$, $p = .010$, $\eta^2 = .06$. The second null hypothesis was rejected. There was a significant impact on math achievement by gender in rural classrooms where AAI was used. This result indicated that the math scores between the control and AAI groups differed for males and females. Figure 2 shows that Female students improved their math scores more than male students. The mean average for females improved by 10 points, compared to the mean average for males, only improving by one point.

Figure 1

Interaction of Therapy Dog Intervention and Control Groups

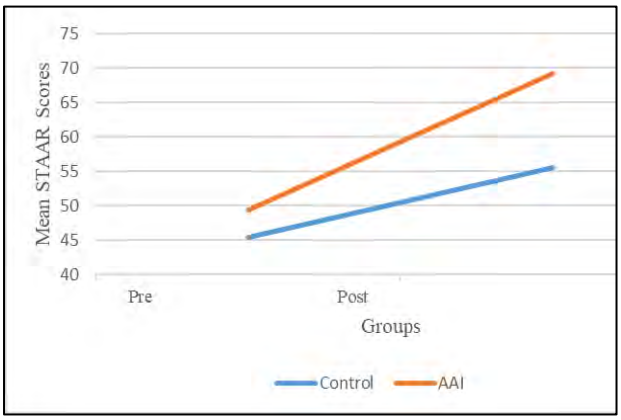
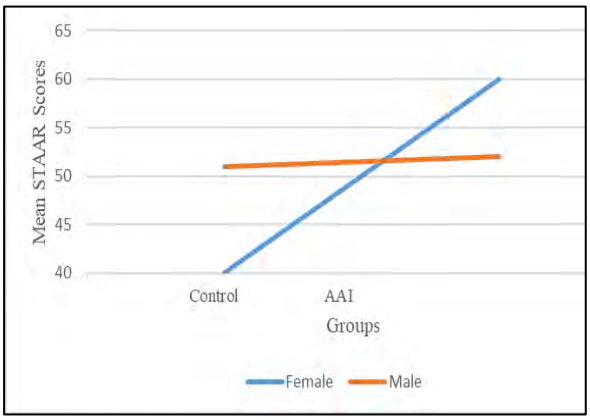


Figure 2

Interaction of Therapy Dog Intervention Group and Gender on Math Scores

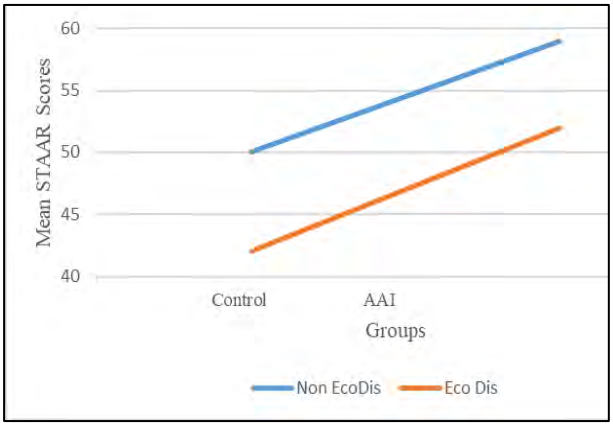


Lastly, sub-RQ 2 was evaluated; what difference is realized in math academic achievement by SES in rural middle schools when therapy dogs are present? In contrast to gender, there was no significant interaction effect of group and economic status on math scores, F (1, 115) = 0.05, p = .822, η^2 = .001. Each group grew parallel, showing equal growth. Therefore, the third null hypothesis failed to reject that there is no impact on math achievement by socioeconomic status in rural classrooms where AAI was used. Figure 3 shows that the difference in math scores between the control group and the AAI group did not vary significantly based on students' economic status.

Additionally, the non-significant interaction effect of group, economic status, and gender on math scores was found, F (1, 115) = 3.65, p = .058, η^2 = .03, indicating that the difference in math scores between the therapy dog intervention and control groups was not different for students who were economically disadvantaged and those who were not, depending on their gender. The mean average increase for economically disadvantaged students was 10 points, compared to non-economically disadvantaged students, with an 11-point average increase in test scores.

Figure 3

Impact of Therapy Dog Intervention Group and Economic Status on Math Scores



Discussion

Increasing academic achievement for rural schools in Texas is becoming more critical as school accountability hinges on student performance. Centerville ISD has tried traditional approaches to improve student academic achievement, including instructional coaching, professional development, and software programs that guarantee results. All measures to improve student academic achievement have yet to provide the results needed to increase student proficiency. The failure to improve student achievement began the evolution of K9U, a program that allows teachers to foster therapy dogs in training for use in their classrooms.

The researcher sought to determine therapy dogs' impact on rural math academic achievement for middle school students. The current study was significant because it added another facet of use for therapy dogs in educational settings. Canines are widely used in reading interventions, counseling sessions, and special education (behavior and autism) classrooms. The current study may help rural schools identify an unconventional method to help with math achievement, as the canines help focus on social and emotional learning, which opens the mind to learn (Payne, 2018). The results of this study were also significant in adding to the overall body of literature on the use of animal-assisted interventions in rural general education classrooms.

Summary of Findings

The primary focus of this study was to determine the impact on students who received an AAI and those who did not. Research question one asked what impact therapy dogs had on rural math achievement. The quantitative approach allowed data from the STAAR test to be collected and analyzed on 123 students enrolled at Centerville ISD. This question was the baseline as it addressed students' overall academic performance in a rural math classroom. The data analysis concluded that math scores increased significantly from 7th to 8th grade. This score increase was significant because of the national below-average scores on the NAEP 8th-grade assessment (NCES, 2022). We know therapy dogs improve reading skills (Bassette & Taber-Doughty, 2016; Fung, 2016; Kropp & Shupp, 2017; le Roux et al., 2014), and this improvement in scores tells us therapy dogs can improve math scores.

The next question, sub-research question one, inquired about the difference in math achievement by gender in rural middle schools when therapy dogs are present. The results indicated that females improved scores more than males when exposed to an AAI. These findings are consistent with females scoring better on reading achievement (Hochweber & Vieluf, 2018; Duckworth & Seligman, 2006; Reilly et al., 2018; Chou, 2019).

The last question used data on the difference in math achievement by socioeconomic status in rural middle school classrooms with therapy dogs present. The data analysis results indicated no significant difference in scores between the control group that received the intervention based on socioeconomic status. Krupp and Schupp (2017) suggested that children living in poverty (low-socioeconomic status) suffer from outside circumstances that can limit their learning ability. It was suggested that therapy dogs could help meet the emotional needs of students living in poverty and help foster improvement in their academic achievement. However, the data of the study indicated that animal assistance intervention did not support the specific subgroup of socioeconomic status.

The results of this study indicated that animal-assisted interventions could be effective in a rural middle school math classroom. Therapy dogs have been helping people for centuries (Hill et al., 2020). Levinson was the forefather of modern animal-assisted interventions, as he noticed his patients talked more when his dog, Jingles, was in the room (le Roux et al., 2014; Walsh, 2009). The improvement in scores from seventh to eighth grade indicates the AAI effectively reduced stress and anxiety, allowing students to learn the content easier (le Roux et al., 2014; Morrison, 2007).

Interpretation of Findings

The impact of therapy dogs in rural math classrooms had gone unmeasured until the current study. Through this study, the researcher stated that animal-assisted interventions positively impacted students in multiple areas of education. There was a need to determine if the exact impact would be realized in the content area of mathematics. This study could imply that therapy dogs in math classrooms are capable of similar outcomes found when dogs integrate into a reading or special education program. The literature backing the therapeutic use of canines is vast; however, the information on the impact in rural math classrooms needs to be more present. This study revealed information beneficial to the AAI community and the use of dogs in the classroom.

The researcher examined research question one and found that overall test scores from 7th to 8th grade improved with the help of canine-assisted interventions. The researcher expected results of overall higher scores. With the significant literature supporting canine interventions in reading, the author expected some of that benefit to be transferable to math skills (Barber & Proops, 2019). This increase in overall scores is significant, especially for Centerville ISD, because traditional teaching and interventions failed to raise scores. The hypothesis was supported, which stated that there was a substantial impact on student math achievement in rural classrooms where AAI is used. Furthermore, the 8th graders across the nation performed below average (NCES, 2022), and this study provides insight into the benefits AAI can provide to rural students. The improvement in test scores for the grade level is exciting for the field, as it hints at canines being as effective in math classrooms as they are in other educational settings.

The second research question examined therapy dogs' impact on genders (male versus female) in rural math classrooms. The results showed that females responded more to the canine AAI, and the scores rose significantly. However, the scores for the males did not show that same growth. Ruby Payne (2018) discussed those boys from low-socioeconomic backgrounds struggle with classroom achievement. The researcher theorized that the presence of a dog in the classroom would give all students more emotional connection and safety and allow them to improve their academic achievement. The study's results demonstrated a different outcome from the researcher's theory. The researcher hoped the achievement could have been higher for males that received the canine intervention. Therefore, the researcher rejected the null hypothesis that there is no significant impact on math achievement by gender in rural classrooms where AAI was used.

The last question in the study addressed the variance in scores among socioeconomic statuses (SES): those that are low-SES compared to those that are not. The researcher hypothesized that there would be a significant impact on math achievement on SES in rural classrooms where AAI is used. Therefore, the null hypothesis failed to be rejected, which stated that socioeconomic status has no impact on math achievement in rural classrooms where AAI

was used. This finding surprised the researcher because, much like gender, canine therapy was expected to impact socioeconomic status performance significantly (Beetz et al., 2012). Research suggests that when students feel emotionally secure, their learning will improve, yielding higher academic achievement (Payne, 2018; Beetz et al., 2012). Canine research suggests that students had those emotional security needs met by petting and bonding with the dog (Zents et al., 2016; le Roux et al., 2014; Walsh, 2009).

The results of this study showed an overall impact of higher scores on students in this rural math classroom. Females were particularly receptive to the intervention, as demonstrated by the significant jump in improvement from 7th to 8th grade (Duckworth & Seligman, 2006). There needed to be more time for each student to bond with the dog or more opportunities to work one-on-one with the canine in the classroom. While implementing the therapy dog intervention in the classroom was carefully thought out, the researcher and classroom teacher could only foresee some potential issues. Overall, the impact of AAI in this rural math classroom was positive.

Implications of Findings

The data analysis of this quantitative study analyzed the impact of therapy dogs on academic achievement in rural math classrooms. The immediate implications of this study are significant to the overall field of AAI, especially those interventions that use canines, as it sheds light on the fact that canine therapy can raise math performance. Schools across the nation have dogs in their facilities for students to read to or to help with students in special education settings; however, the results of this study suggested that their school dogs can be used in a math setting as well.

Previous research supports using AAI for reading improvement, behavioral regulation, and to help counsel. However, canines are helpful in other educational settings, as evidenced by the results of this study. Bhandari (2020) discussed generalizing skills from one context to the next. The researcher believes the practice of reading to a dog can be generalized to the math classroom to specifically address concepts like math fact fluency, fractions, and time. With reinforcement in these essential math building blocks, there is potential for dogs to be as effective in math as they have proven to be in reading.

By having a classroom resource that can bond with students, help students feel calm, and provide a sense of security and confidence (Sokal & Kahl, 2019), Texas schools can begin to close the academic achievement gap in math. With more students performing on grade level, the accountability ratings for schools using therapy dogs in math classes would increase. The therapy dog program aims to reduce stress and help problem-solving skills (Zents et al., 2007), and this study implies that canine AAI can help do that in math, leading to higher scores.

Limitations and Delimitations

Most research studies have limitations that must be evaluated when looking at the study results. There could be possible threats to the validity of the study. Internal threads to validity include the history and maturation of the students. History threatens internal validity due to not knowing if a student has an unknown preference or issue with the canine. Based on their history, students may need to be more engaged when the trained therapy canine is present. Another limitation that could impact internal validity is that of maturation. The researcher can only definitively say the growth in scores is from the canine because students mature between 7th and

8th grade. The most significant external validity limitation is that of a situation effect. This study involves multiple class periods that occur all day long. The composition of the students in the classroom can make bonding with a canine or learning the presented content more difficult. The composition of students must be considered when examining the study's results. The most significant limitation was the school's location and sample size. The study could have had a more robust effect size had there been enough student population to have a larger control group. All these limitations must be considered when evaluating the results.

This study's primary delimitation is that only one school and one teacher provided the data. While the researcher consciously made that decision, it is a choice that must be examined when analyzing the data. The results of this study came from a small population sample. Had the researcher included more schools, the results data could have been much stronger; however, that was not a risk the researcher was willing to take. While other local schools have K9U programs, the researcher needed to speak to the fidelity of implementation and the access students have to the canines during core content classes, such as math. Therefore, the researcher opted for a delimitation of the setting.

The completion of this study demonstrated the benefit of using canine AAI in other content areas, specifically math. The primary goal of this study was to determine if therapy dogs impacted math achievement in rural middle school math classrooms. While there were positive outcomes in the study, more work needs to be done to ensure that canines can positively impact math achievement in the same way that canines impact reading achievement.

Conclusion

The research findings of this study showed an overall increase in scores from 7th to 8th grade with canine intervention. Furthermore, the results indicated that females responded more favorably than males to the intervention. There was no discernable difference in academic achievement in response to intervention between high and low-socioeconomic student groups. The researcher found no scientific information on using canine AAI in math classrooms to improve student achievement. Any further research in this area would be ground-breaking and provide additional information on the impact canines can make in math settings.

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