CONCUSSION IN SCHOOL-AGED CHILDREN: EVALUATING THE EFFECTIVENESS OF AN ONLINE CONCUSSION TRAINING PROGRAM

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CONCUSSION IN SCHOOL-AGED CHILDREN: EVALUATING THE EFFECTIVENESS OF
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ABSTRACT

CONCUSSION IN SCHOOL-AGED CHILDREN: EVALUATING THE EFFECTIVENESS OF AN ONLINE CONCUSSION TRAINING PROGRAM

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This study utilized a mixed-methods design to evaluate the effectiveness of online concussion training programs at increasing school professionals’ concussion awareness, knowledge and confidence in concussion identification and response and their ability to apply skills in relation to concussion recognition and response. Participants \( n = 30 \) in the Teacher Training and \( n=11 \) in the Team Training completed the training online and had access to the training manual and resources online. Prior and gained knowledge were measured through pre- and post- tests. Results indicated that both the Teacher and Team online trainings yielded significant results in increasing confidence in concussion identification and response, as well as knowledge and awareness of concussion. The Teacher Training also indicated significant results in relation to increased skills application. Additionally, a content analysis of pre- to post- test responses on qualitative
questions showed an increase in word count, depth in response, and use of training terminology in response to skills application questions on the Teacher Training, and participant role in concussion response teams on the Team Training. Limitations and implications for future use of online concussion training programs for teachers and other school staff are discussed.
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CHAPTER I
INTRODUCTION

In the United States, an estimated one million children sustain a concussion, or mild traumatic brain injury (mTBI) each year, not including those that are unreported (Arroyos-Jurado, Paulsen, Merrell, Lindgren, & Max, 2000). Though the term “mild” may elicit assumptions of minimal effects, mTBIs in school-aged children can have significant, lasting symptoms for days, weeks, or even months post injury, especially when a child has sustained multiple mTBIs (Mason, 2013). School-aged children sustain a large proportion of the TBIs in the United States, with pre-school children and adolescents aged 15-19, particularly at risk (Rieger, et al., 2013). Due to high levels of engagement in physical activity, which increase the risk for accidents, along with the developmental anatomy of a child’s body, children and adolescents are highly susceptible to mTBIs, or concussion, which is a type of mTBI (Mason, 2013).

Though there is an increased understanding and awareness of the significant effect concussion can have on students’ cognitive, academic, behavioral, social, and emotional abilities in recent years, many U.S. schools still do not train faculty and staff in concussion recognition, nor do they have concussion management plans in place (Arroyos-Jurado, et al., 2000; Davies, 2014). It is important for school districts to be aware of the unique needs of students who have sustained a concussion, and specifically,
to have a plan in place for appropriately returning students back to physical and academic activity (Davies, 2014).

Concussion recognition and response programs currently exist. Several notable programs include the Colorado Department of Education’s Concussion Management Guidelines (2014), CDC’s Heads Up program (2007), Nationwide Children’s Hospital’s Concussion Clinic Resources for Education (2012), and Pennsylvania’s BrainSTEPS (2015). However, few peer reviewed studies have systematically evaluated the outcomes of these programs.

In 2015, the Ohio Department of Health (ODH) initiated a pilot project to address a deficit in the training of school professionals on concussion recognition and response in Ohio. Dr. Susan Davies (who also serves as chair of this thesis project) created and implemented a concussion training module in four Ohio school districts, and also crafted two online training modules, based on the aforementioned module, to be distributed to additional school districts.

The present study examined the efficacy of the online training component of the ODH concussion training programs, which were created with elements of the notable programs listed previously, in addition to current research. The training program included two online training modules: a thirty minute audio visual training for teachers, and a seventy five minute audio visual module accompanied by a support manual, to be used for the development of a school-based Concussion Team (including teachers, school psychologists, school counselors, nurses, and athletic trainers). Several school districts throughout Ohio participated in the online training in the 2016-17 school year to educate and train school staff and faculty on how to identify concussion and how to aptly
transition students back into school and play activities following a concussion. Participants in the present study represented a range of roles in the school system, including: administrators, athletic coaches, sports officials, school psychologists, intervention specialists, teachers, educational aides, occupational therapists, and nurses. The researcher evaluated the program’s effectiveness with the following two research questions: 1) How do ODH online state concussion training programs affect concussion awareness, knowledge, and confidence in concussion identification and response in school professionals? 2) How do ODH online state concussion training programs affect participants’ ability to apply skills in relation to concussion recognition and response?

The present study consisted of four variables: two independent variables, and two dependent variables. The independent variables were the two ODH online concussion training programs. The dependent variables were: 1) participants’ awareness, knowledge and confidence in concussion identification and response, and 2) the participants’ ability to apply skills in relation to concussion recognition and response, which was determined through data analysis of pre- and post- tests.
CHAPTER II
LITERATURE REVIEW

The literature review begins with an overview of concussion symptoms and signs, as well as the neurological changes that occur in the brain when a child or adolescent sustains a concussion. The literature review addresses causes of concussion, risk factors related to sustaining a concussion, and the prevalence of concussions in school-aged children. It investigates reasons for the lack of concussion awareness and protocol in schools and the adverse effects of untreated and mistreated concussions. Further, the literature review summarizes current law regarding concussion response and treatment in schools, as well as current and past school-based concussion programs and initiatives. The concussion school team model is described, as well as Return-to-School and Return-to-Play protocols. Next, the literature review describes the value and limitations of online training programs in comparison to face-to-face training. The literature review concludes with information related to the lack of awareness and limited number of school programs on concussion response, as well as a rationale for the present study.

Concussions in School-Aged Children

In the United States, an estimated one million children sustain a concussion each year; however, it is difficult to accurately account for the quantity of concussions due to the number of mild traumatic brain injuries (mTBI), or concussions, that go unreported
each year (Arroyos-Jurado, Paulsen, Merrell, Lindgren, & Max, 2000). Traumatic brain injury (TBI) is largely defined as an injury that causes disturbance to normal brain functioning that can be caused by a direct hit, jolt, or bump to the head, or, by receiving a hit to another part of the body that causes rapid acceleration or deceleration to the head and neck (Faure, 2010, Center for Disease Control, 2015). TBIs are classified as either mild, moderate, or severe. While there is some debate regarding terminology, mild traumatic brain injuries (mTBI) are typically referred to as concussions. Classifications of TBI are based upon scores on the Glasgow Coma Scale (GCS; CDC, 2015). Teasdale, Jennett, and Lancet created the GCS in 1974 to measure the severity of TBI. The GCS measures Best Eye Response, Best Verbal Response, and Best Motor Response on a scale, with scores ranging from 3 (worst) to 15 (best; CDC, 2015). Faul, Xu, Wald, and Coronado (2010) define a mild TBI as “a brief change in mental status or consciousness”, and a “severe” TBI as “an extended period of unconsciousness or amnesia after the injury” (p. 8). In 2009, the CDC estimated that approximately 75% of TBIs reported are mild, and that children, adolescents, and older adults are most likely to sustain TBIs (CDC, 2013).

When an injury is labeled as mild, it is referring to the severity of the injury at the time of initial impact, and not the resulting outcome; this largely depends on post-injury treatment. Children and adolescents who sustain a concussion may still experience symptoms weeks--and even months--post-injury due to the fact that much of the brain injury and symptoms from sustaining a concussion occurs after the initial impact (CDC, 2013, Lewandowski & Rieger, 2009). When a concussion is sustained, neuronal fibers in the brain are stretched, or damaged, which disrupts cell metabolism, blood flow,
oxygenation, and neurotransmission (Mason, 2013). These neurometabolic changes that accompany a concussion are generally reversible; however, recent neuroimaging techniques have shown that axonal damage can still occur after sustaining a concussion, especially if proper post-injury treatment is not followed (Rieger, et al., 2013). The CDC (2013) explains concussion as the initiation of a “complex biologic cascade, which begins immediately after the trauma and can continue for hours to weeks after the initial injury” (p. 549).

**Signs and symptoms.** Concussions present different levels of severity of signs and symptoms depending on the child’s age and history of concussion, as well as the injury. Common initial symptoms include, but are not limited to: dizziness/vertigo, visual disturbance, nausea/vomiting, fatigue, emotional-behavioral symptoms, and slowed processing-speed (Rieger, et al., 2013). Concussion symptoms fall into four categories, including: physical, cognitive, emotional, and sleep. Physical symptoms of concussion include: headache, nausea, balance problems, visual problems, fatigue, and sensitivity to light and noise. Cognitive symptoms include: Feeling mentally “foggy”, feeling “slowed down”, difficulties with remembering and concentrating, poor short-term memory, and confusion. Emotional symptoms include: Irritability, sadness, nervousness, and feeling more emotional. Sleep symptoms of concussion include: drowsiness, sleeping more or less than usual, and difficulty falling asleep (Halstead, Walter, & The Council on Sports Medicine and Fitness, 2010). Many of the signs and symptoms of concussion bear similarities to depression, anxiety, attention-deficit disorders, and learning disabilities. In students with these mental-health disorders, sustaining a concussion may intensify such
symptoms, likely increasing the duration and difficulty of recovery (Halstead, Walter, &

Loss of consciousness (LOC) at the point of injury is commonly assumed to be
one of the significant indicators of concussion; however, LOC actually occurs in less than
10% of concussions, and usually indicates a more severe TBI, depending upon the length
Children who sustain a concussion may experience decreased levels of consciousness,
which can last for less than 30 minutes; if this symptom exceeds 30 minutes, the injury is
considered “moderate” to “severe” (Mason, 2013). Along with LOC, other “red flag”
symptoms that indicate a moderate or severe TBI include: changes in mental status,
headache, changes in speech, vomiting, changes in mobility, seizures, and pupil changes
(Mason, 2013).

When a child sustains multiple concussions, symptoms are likely to increase in
severity and duration, which results in a more difficult and lengthier recovery, and in
some cases, permanent damage to the brain (Mason, 2013). Sustaining two consecutive
concussions can result in permanent brain damage, and even fatality, in some cases.
When a second concussion is sustained while the individual is still experiencing
symptoms from the initial injury, a child may suffer from second-impact syndrome. The
second concussion causes considerable cerebral swelling and significant damage to the
brain (Bompadre, et al., 2014). It is imperative that concussions are recognized, reported,
and managed correctly to minimize the risk of second-impact syndrome, as well as the
associated short- or long-term health and behavioral problems, which can occur if
concussion is not properly recognized and managed. When concussions go unrecognized
and are not reported and treated, the injury can significantly affect student learning, thinking, behavior, and/or emotions.

Concussion assessment. Concussions are difficult to diagnose; as many of the initial signs have often passed by the time the patient has reached a clinical setting. Further, if a student sustains a head injury and shows severe symptoms (i.e., LOC, seizures, pupil changes, possible skull fracture, etc.) he or she may receive magnetic resonance imaging (MRI) and computed tomography (CT) scans, which are often not sensitive enough to detect subtle brain impairments when the injury is a mTBI or concussion (Lewandowski & Rieger, 2009). In a review of medical records of patients admitted to the pediatric trauma service between 2008 and 2011 for sustaining a sports-related concussion, CT scans were given to 72 of the 80 concussion patients on the day of injury, 56 of which were read as normal (Bramley, et al., 2014). Results of this study show that sports-related (field or court sports) concussions are less likely to yield clinically significant or abnormal CT results, especially in comparison to high-velocity (biking, skiing, snowboarding, etc.) activity concussions. However, though CT scans may not show clinically significant changes in the brain, neuropathological changes often still occur.

In addition to medical difficulty of diagnosis, concussion symptoms are difficult to directly observe and detect. For example, a student may feel confused, have difficulty with memory and concentration, or have a headache. Each of these symptoms is difficult to observe and record. Thus, concussion evaluation and assessment are largely based upon self-reporting symptoms. Unfortunately, this form of assessment is not entirely reliable due to risk of exaggeration or minimization of symptoms.
Although assessing or grading concussions is a difficult task, it is important to identify the severity and significance of symptoms a student is experiencing in order to appropriately treat the injury and assist in transition back to school and play. Davis and Purcell (2014) conducted a literature review to assess the evaluation that currently exists for children aged 5-15 who have sustained concussion. Results of the review concluded that there is no single pediatric concussion assessment tool validated for use at the time of injury through to all stages of recovery. Several validated symptom scales can be used during different stages of follow-up assessment for children. Currently, the commonly used assessments are symptom-based, and include evaluation of vision, cognition, behavior, and severity of symptoms. These commonly used assessments include: The *Family Assessment Device General Functioning Scale* (FAD-GF), which measures the general functionality of the family-system prior to the child sustaining concussion (Stancin, et al., 2002), the *PedsQL 4.0 Generic Core Scales* and *Cognitive Functioning Scale*, which measures Health Related Quality of Life (HRQoL), including physical, emotional, social and school domains, as well as cognitive functioning (Pieper & Garvan, 2014), the *Sport Concussion Assessment Tool 3*, side-line assessment that includes the Maddocks questions, which evaluate orientation and short- and long-term memory (Halstead, Walter, the Council on Sports Medicine and Fitness, 2010), the *Immediate Postconcussion Assessment and Cognitive Testing* (ImPACT; McLaughlin, 2012), and the *Acute Concussion Evaluation* (ACE; CDC, 2015). Additionally, Marco and Broshek (2016) reviewed literature pertaining to computerized cognitive testing in concussion assessment. Marco and Broshek (2016) reviewed the following assessments: *Immediate Post-Concussion Assessment and Cognitive Testing Battery*, an expanded assessment of
Verbal Memory, Visual Memory, Processing Speed, Reaction Times and Impulse Control, *Multimodal Assessment of Cognition and Symptoms for Children*, which assesses Response Speed, Learning & Memory, and Accuracy/Speed Efficiency, *Automated Neuropsychological Assessment Metrics*, which includes concussion batteries measuring Simple Reaction Time and Spatial Processing, and the *Axon Sports Computerized Cognitive Assessment Tool*, which takes less time to administer than the aforementioned assessments and measures similar areas. While in-depth descriptions of these assessment instruments are beyond the scope of this literature review, it is important to note that none of these tools are proven valid in the assessment of the effects and implications of the injury throughout recovery; a combination of the above instruments is recommended when assessing concussion severities and symptoms (McCrory, et al., 2013). It is also important to note that concussion diagnosis and return to play decisions are a medical decision and should be based on clinical judgment, and that cognitive assessments should only be administered by qualified and trained professionals (McCrory, et al., 2013, Marco & Broshek, 2016).

**Causes of concussion.** Preschoolers and adolescents are at a greater risk of sustaining concussion than any other population (Bellerose, Bernier, Beaudoin, Gravel, & Beauchamp, 2015, Mason, 2013). This is true for preschoolers due to anatomical differences in body and brain development. Adolescents, on the other hand, are at risk due to greater likelihood to engage in high-risk behavior, and highly physical sports and recreation (Mason, 2013, Davies, Trunk, & Kramer, 2014). The CDC (2013) reports the leading causes of concussion in the general population to include falls (35.2%), motor vehicle crashes (17.3%), blunt impact (16.5%), and assaults (10%). A review of TBI
emergency department visits, hospitalizations, and deaths in the United States found that fall-related TBIs increased 62% in children aged 0-14, from 2002-2006 (Faul, Xu, Wald, & Coronado, 2010). These statistics show that though concussions are commonly sustained in sports, they can also occur off the field; for example, falls and blunt impact are also sustained in non-sports related activities (i.e., running, playing on playground/swing set, bike riding, skateboarding, etc.).

In a similar review, Bramley and colleagues (2014) evaluated the medical records of patients admitted to the pediatric trauma service between 2008 and 2011 after sustaining a sport-related concussion. Two hundred and twenty eight pediatric patients were admitted to trauma service with a mild traumatic brain injury during this time period; 80 (35%) of those patients sustained a concussion while participating in recreational or sports-related activities. High-velocity activities accounted for 74% of the concussions and 26% of the patients sustained a concussion from a court or field sport. In this review, football accounted for more than a third of the field/court concussions, and ATV/motorcycle and biking incidents accounted for half of the high velocity concussions.

**Prevalence in school-aged children.** Data from TBI-related emergency department (ED) visits between 2002-2006 show that children aged 0-14 years represented an estimated average of 473,947 ED visits in that time frame, whereas adults aged greater than or equal to 65 years of age, only accounted for 141,998 ED visits. Data from this review show that children aged 0-14 years are at an increased risk of sustaining TBI. The fact that most of these children are school-age highlights the importance of
school systems recognizing and managing concussions, as well as promoting concussion awareness in students and staff (Faul, Xu, Wald, & Coronado, 2010).

In a similar study, Colvin and colleagues (2013) examined data collected from all Children’s hospitals participating in the Pediatric Health Information System in the USA over a 10-year period (2000-2010). Results showed that the number of ED visits for concussion increased from .36% of all ED visits in 2000, to .62% of all ED visits in 2010, while the general number of admissions remained stable. Further, the number of pediatric ED visits for concussion nearly doubled in the 10-year period. This significant increase in concussion occurrences may be due in part to a greater awareness of concussion, resulting in increased recognition and higher reporting rates.

In a study investigating the magnitude of unreported concussion in high school football players, McCrea, Hammke, Olsen, Leo, and Guskiewicz (2004) found that only two-thirds of high school athletes recognized when they had sustained a concussion, and that only 43% of those students reported the injury. Lack of concussion awareness plays a large role in low student concussion reporting, as well as the fear of being taken out of play. Female athletes had a higher rate of concussion than boys in similar sports; one likely explanation is that females are more prone to concussion because they have weaker neck muscles and a smaller head mass than males. Others theorize that females may be more likely to report concussion symptoms (Halstead, Walter, & The Council on Sports Medicine and Fitness, 2010). The difference in male versus female concussion rates is likely attributed to both factors.
Concussion Awareness in Schools

TBI is commonly referred to as the “silent epidemic” due to the difficulties in recognizing and diagnosing TBI, as well as the covert nature of the symptoms, such as changes in emotions, sleep, language, reaction time, and thinking (Faul, Xu, Wald, Coronado, 2010). Unfortunately, school professionals are often not trained in concussion recognition, response, or management, which leads to poor care for students who have sustained a concussion. Considerable research exists on return-to-play decisions, which mandate when students who have sustained concussion can return to athletics and play; however, very little exists regarding return-to-learn practices (Lewandowski & Rieger, 2009). Readiness for return-to-play should be carefully considered in regard to student recovery; however, a thoughtful and documented process for returning a student back to learning is also critical, as most concussion symptoms can affect thinking, learning, and listening.

Many students who have sustained concussion require academic adjustments (i.e., giving fewer questions on homework assignments), which should be implemented by school professionals and can be removed when the student is asymptomatic. Williams, Welch, Parsons and McLeod (2015) surveyed 851 secondary school Athletic Trainers (AT) via email which included multiple-choice questions regarding their perceived familiarity with, attitudes about, and incorporation of academic adjustments for student athletes after a concussion. Specifically, ATs were surveyed about their self-perceived familiarity with 504 plans and Individualized Education Plans (IEP) for student-athletes who have sustained a concussion. Results of the survey indicated that only 40% of AT’s patients who sustained a sport-related concussion received academic adjustments.
Additionally, results showed that ATs employed directly by secondary schools were more familiar with academic adjustments. Overall, this study suggests that it is important for ATs to be familiar with return-to-learn along with return-to-play, whether directly employed by a school, or not.

Many parents and students are also largely unaware of the risks of concussion. McLaughlin (2012) reported that when parents with children-athletes aged twelve to seventeen were surveyed on their concussion knowledge, only 8% of parents had heard a “substantial” amount of information regarding the risk of repeated concussions, and 36% reported not having heard anything about the risks.

**Effects of untreated/mistreated concussion.** When students, parents, and school professionals are not adequately educated on the signs, symptoms, risks, and appropriate management of concussion, students do not receive the accommodations and treatment they need post-concussion. Students who are recovering from concussions often require a great deal of assistance at home, school, and in the community. Students frequently require academic adjustments, and sometimes even temporary special education services. When prematurely returned-to-play and/or returned-to-learning, students may experience prolonged recovery of concussion symptoms, including impairments in working memory, motor skills, language, verbal fluency, concept formation, and general cognition and behavior (Arroyos-Jurado, Paulsen, Merrel, Lindregen & Max, 2000). These symptoms may adversely affect one’s education, and even persist into adulthood, if left untreated or mistreated. When students prematurely return-to-play they have an increased risk of sustaining a second concussion, and may suffer from *second-impact syndrome*, which can cause significant brain damage (Bompadre, et al., 2014).
Current Law Regarding Concussion Response and Treatment in Schools

Prior to 2009, there was no legislation that addressed concussion reporting, documentation, and management in schools. However, after a tragic school-sports-related concussion, a law regarding concussion management in schools was signed in 2009 (Bompadre, et al., 2014).

**Zackery Lystedt Law.** On May 14, 2009, the first concussion law in the United States was signed by the governor of the state of Washington. A terrible head injury sustained by a high school football player in 2006 inspired this law: Zackery Lystedt, a then-junior in high school, sustained an initial concussion in the second quarter of a football game. He was allowed to return-to-play, despite showing common signs of concussion. Zackery sustained many more blows to the head and body throughout the game. At the end of the game, Zackery collapsed and was taken to the hospital, where he underwent emergency brain surgery. Luckily, Zackery survived, though he has permanent disability and significant neurologic injury.

The Zackery Lystedt Law (ZLL) went into effect in July 2009 in his honor, and includes three components:

1. The education of athletes and parents or guardians on concussion, and the signature of the athlete and parent or guardian on a form, which provides this information. The law also includes mandatory coach’s education on concussion.
2. The removal of youth athlete from practice or play at the time of a suspected head injury or concussion.
3. The allowance of return to practice or play only with the written permission of a licensed health care provider, who is trained in the evaluation and management of concussion (Bompadre, et al., 2014).

A recent study examining the effect of the ZLL on injury and concussion documentation and identification was conducted in Seattle-area public high schools. Data were collected during the school year before the Lystedt law took effect (2008-09) and for two years after the law took effect (2009-2010, and 2010-2011). Data were collected with students aged 13 to 19 years. In 2008-2009, the concussion rate, in relation to the three year average, within the school system was -1.09% in 2009-2010, and 2.26% in 2010-2011. Thus, the number of documented concussions more than doubled after the institution of the ZLL, suggesting that the law resulted in heightened awareness and closer monitoring, thereby raising rates of concussion reporting (Bompadre et al., 2014).

Additional legislation. A section of the Zackery Lystedt Law which states that coaches and trainers are primarily responsible for managing on-site concussions, inspired similar laws which are now upheld in most states (Sharma & Cusimano, 2014). In 2012, Tomei, Doe, Prestigiacomo, and Gandhi investigated current practices in concussion recognition and response across the United States in regards to state legislation. Findings suggested that, although all states had legislation to support educating coaches on concussion, only 48% require coaches to participate in formal concussion education. However, 86% of states require that athletes are educated, and 88.7% require that parents are educated. In 75% of the states, a child must be removed from play if a concussion is suspected, and in 16% of the states the presence of signs and symptoms of concussion
require immediate removal from play. Overall, state law varies greatly regarding the individual designated to evaluate and clear a student athlete to return to play.

Each of the 50 states now has current law regarding concussion in schools. Much state legislation regarding concussion denotes the importance of when to remove and return students to play. Nebraska, Virginia, and Idaho are currently the only states in the country that mentions protocol on when to return students back into the learning environment, however, several states have proposed legislation, but the acts have either failed or adjourned (“Traumatic Brain Injury Legislation” 2015, “Injury Prevention Legislation Database” 2017). This is problematic because deciding when and how to return students back into the classroom is often overlooked, but is pertinent to student recovery, as discussed later in this chapter. The varying legislation regarding when and how to return students to play and return students to learning, highlights the significance of this study’s Ohio concussion online training modules.

Existing Concussion Programs

Though legislation is fairly vague in regard to specific training of school professionals, and treatment/management plans to be implemented in schools nationwide, several initiatives have been implemented in schools throughout the country. Peer reviewed articles on the efficacy of current concussion programs are limited, and those that exist are based solely on concussion education and protocol for coaches only.

Concussion teams. One component that most existing programs have in common is the utilization of some form of a concussion team model. Such a team consists of a group of school professionals who are each educated on concussion, return-to-school and return-to-play, and each play a specific role. The Colorado Department of Education
Concussion Management Guidelines (2014), for example, defines the concussion management team as three entities:

1. The Family Team, which consists of the student, parents, guardians, siblings, and student peers.

2. The Medical Team, which consists of (depending upon resources and needs) Doctor of Medicine, Doctor of Osteopathic Medicine, Nurse Practitioner, Physician Assistant, and a Licensed Psychologist.

3. The School Team, which has two entities: the physical team which may include an athletic trainer, school nurse, coach, and physical education teacher, and the academic team, which may include, the teacher, counselor, school psychologist, school social worker, and the administrator.

Most existing concussion response programs also recommend use of return-to-play and/or return-to-school protocols, which are imperative to a successful and timely recovery for students. The training developed for the current study views the concussion team as one collaborative team, which functions through the school and is led by a concussion team leader (i.e., school psychologist, athletic director, school counselor, etc.).

**Return-to-play protocol.** Return-to-play (RTP) after concussion is a largely controversial topic, due to the difficulty in determining the appropriate time to return students back to sport and play. Current research and legislation recommends that students should not be returned to the field of sports (or other-related play) if concussion is suspected, and that students not return to play until full clinical and cognitive recovery is reached (McKeon et al., 2013). At the third annual International Conference on
Concussion in Sport, held in Zurich in 2008, a six-step approach to RTP was recommended, and is widely used internationally. Generally, each step should last 24 hours. If any post-concussion symptoms occur while in one of the progressed steps, the student should go back to the previous asymptomatic step and allow an additional 24 hours until trying to progress to the next step. The six steps for RTP after sustaining a concussion (McCrory, et al., 2009) are as follows:

1. **No activity**, with complete cognitive rest while student recovers.

2. **Light aerobic exercise**, which can include: walking, swimming, or stationary cycling with sustaining intensity <70% maximum predicted heart rate.

3. **Sport-specific exercise**. Student can be returned to practice, but cannot participate in head impact activities.

4. **Non-contact training drills**. Student can begin progression to more complex training drills.

5. **Full contact practice**. Once student has received medical clearance, they can participate in normal training activities. During this stage, students should begin to restore confidence and assess functional skills by the coaching staff.

6. **Return to play**. Student can participate in normal game play.

McKeon et al. (2013) conducted a study to determine probability estimates for the time until RTP after sports-related concussion among high school athletes. Data were collected from seven high schools in central Kentucky during the 2007-2009 and 2008-2009 school years by the athletic trainers in each school regarding student-athlete concussion RTP for students who had sustained a concussion. Results showed that after a new concussion, students’ RTP probability at 1 to 2 days was 2.5%; the probability
increased to 35% for a 3-day RTP, 71.3% for a 7-day RTP, and 88.8% for a 10-day RTP. There was no increase again for a 22-day RTP. It is important for school systems to be educated in RTP protocol for the safety of students and student-athletes.

**Return-to-school protocol.** As mentioned previously, return-to-school protocol is often a second-thought to return-to-play; however, research has shown that concussion can negatively affect school performance, and returning to school too early can worsen symptoms and extend recovery (Taylor, et al., 2002). In cases of severe traumatic brain injury, it is important to note that children are often released within a day or two, while symptoms may still be severe, and that return-to-school decisions should be made in collaboration with medical professionals (Bramley, et al., 2014). In addition, returning to school too late can lead to academic failure and greater difficulty catching up.

DeMatteo and colleagues (2015) developed a Return to School (RTS) concussion protocol following the National Institute for Health and Care Excellence procedures, in response to a lack of protocols focused on returning children to school after a concussion. The purpose of this study was to develop a concussion protocol/procedure to implement in schools to help transition students who have sustained concussion back to school appropriately. DeMatteo’s RTS protocol focuses on four main aspects of school adaptation after concussion, including: timetable/attendance, curriculum, environmental modifications, and activity modification. Gioia (2016) suggests that in addition to DeMatteo’s four main aspects (2015), an Exertion Regulation protocol be put in place. Gioia proposes protocol regarding Activities of Controlled Exertion (PACE), which includes three stages: 1) Set the Positive Foundation 2) Define the Parameters of Activity-Exertion 3) Teach Activity-Exertion Monitoring Skills and 4) Reinforce
Progress. Gioia’s PACE protocol represents a significant addition to concussion response that includes the management of emotional response and self-monitoring of exertion. DeMatteo and colleagues (2015) discuss the importance of cognitive rest and a timely return to school for students following a concussion. Though RTS and RTP protocols exist, they do not necessarily provide schools with specific training, education, and planning related to concussion response and recovery of students. Therefore, RTS and RTP guidelines should be accompanied by a school-wide concussion initiative or program.

**Heads up: Concussion in youth sports.** The Centers for Disease Control and Prevention (CDC) created a concussion initiative for schools entitled: “Heads Up: Concussion in Youth Sports.” The program includes resources on concussion awareness, recognition, and response for parents, schools, and health care providers, as well as for high schools and youth sports associations. “Heads Up” resources include fact sheets, tips on return-to-learn and return-to-play, and symptom checklists to help monitor concussion symptoms.

Covassin, Elbin, and Sarmiento (2012) administered a 22-item survey to 340 youth sports coaches to evaluate the effectiveness of the CDC’s “Heads Up: Concussions in Youth Sports” materials in preventing, recognizing, and responding to concussions in schools. All respondents to the survey reported having the “Heads Up” materials for 6 months prior to completing the survey. Results of the survey suggested that the “Heads Up” program assisted 77% of youth coaches in identifying athletes who sustained a concussion; 50% of the coaches reported learning something new about concussion through “Heads Up”; 63% of coaches reported viewing concussions more seriously after
reviewing the “Heads Up” materials, and 72% reported that they are now educating others on concussion.

**Heads up football.** In 2012, USA Football created the Head Up Football (HUF) educational program, which targets training on correct equipment fitting, tackling technique, concussion awareness, and strategies for reducing player-to-player contact. HUF primarily focuses on modifying practice activities, and creates policies aimed at lessening the accumulation of head impacts and the incidence of concussion. Kerr and colleagues (2015) conducted a study to evaluate the effectiveness of the HUF program on decreasing the number of head impacts in youth football players in practice and games. Seventy youth football players aged 8 to 15 years wore xPatch accelerometers to measure head impact exposure during the 2014 season. Thirty eight players were involved in the HUF program, and thirty two were not. Kerr and colleagues (2015) found that players who received HUF experienced lower rates of head impacts during practice than players who did not receive the program.

**BrainSTEPS.** In 2007 the Pennsylvania Department of Health created BrainSTEPS (Strategies Teaching Educators, Parents, and Students) to assist school districts in appropriately returning students to school and to play after sustaining a brain injury (Brain Injury Association of Pennsylvania Inc., Pennsylvania Department of Education, & Pennsylvania Department of Health, 2015). BrainSTEPS is a state-supported program that trains school professionals and collaborates with families to help return students who have sustained a mTBI to school. The program also supports students who have been previously identified with a mTBI and are in need of continued educational accommodations.
BrainSTEPS provides training on mTBI recognition and response through local educational, medical, and rehabilitation facilities; however, BrainSTEPS specializes in assisting students in the school setting. BrainSTEPS consists of 31 statewide consulting teams, which consult with schools regarding return to school, IEP/504 Plan development, intervention development and implementation, and monitoring of students who have sustained a mTBI. Though the efficacy of this program has not undergone rigorous external evaluation, BrainSTEPS is a well-known model statewide program for brain injury educational consulting.

BrainSTEPS employs a Concussion Management Team (CMT) format; however, unlike other programs, it relies primarily on two in-school professionals: an Academic Monitor and a Symptom Monitor. The family members and other school professionals involved with the student who sustained concussion are strongly encouraged to collaborate in the recovery and monitoring process as well. BrainSTEPS state team members assist in consultation and monitoring, especially if a student’s symptoms last longer than four weeks. BrainSTEPS team members also train the school-based CMT, and other parties, in concussion recognition and response. Training can take place face-to-face, but is largely delivered online via a 3.5 hour training webinar, accessed from the BrainSTEPS website, and accompanied by an electronic toolkit (Brain Injury Association of Pennsylvania Inc., Pennsylvania Department of Education, & Pennsylvania Department of Health, 2015). No known studies have examined the efficacy of this web-based training.
The Efficacy of Online Training Programs

Online training programs such as webinars, online modules, and other electronic sources used for specific educational purposes, are increasingly used due to accessibility, cost effectiveness, and convenience. In a recent study, Pelayo-Alvarex, Perez-Hoyos, and Agra-Varela (2013) compared the educational efficacy and level of patient care experience and health of physicians who received palliative care (PC) training through an online model with those who received traditional training. One hundred and sixty nine physicians were randomly assigned to receive the online training model or traditional training. To measure the clinical effectiveness of an online PC training, caregiver satisfaction, symptom control, and quality of life were measured post-training. PC knowledge of physicians was also collected 18 months post-intervention to measure long-term effectiveness. Results demonstrated that physicians who received the online model had reduced scores in their patient’s pain, symptoms, and family anxiety, and also significantly increased their knowledge in PC, compared to physicians who received traditional training. Participation in the online training was significantly higher than the traditional training, with 86.6% of participants completing the online model and only 13.4% of participants completing the traditional training.

In another study, Snyder (2010) evaluated the effectiveness of an online reading and literacy instructor training program. The program was created to train instructors in a rural area who had difficulty accessing on-campus courses at universities. Participants were surveyed post-training on their perceived preparedness for a position as a reading or literacy instructor based upon their online training experience. Results showed that 74.4% of participants felt the online program was effective to extremely effective in preparing
them to be a literacy instructor, and 68% reported the program as effective to extremely
effective in preparing them for a teaching position. Objectives of the program were rated
between *addressed* to *thoroughly addressed* by 83.8% of participants. Through post-
training interviews, participants expressed that the course would have been more
effective if thoughtful online writing assignments were required; they also indicated that
a face-to-face meeting would have been helpful in reinforcing the online content.

A mixed approach to online learning, which involves both online and face-to-face
components was implemented by Douglas, McNaughton, and Light (2013), who studied
an online training model for paraeducators to support communication of young children
with disabilities. This training model incorporated two components, including: traditional
lecture on children’s communication for 90 minutes, and online training consisting of
five modules for 62 minutes. Results showed that the combination of online training and
traditional lecture was effective in increasing paraeducators’ ability to increase the
number of opportunities for children to communicate. However, no data were provided
regarding the efficacy of this mixed approach in comparison to entirely online or entirely
face-to-face trainings.

Pelayo-Alvarex, Perez-Hoyos, and Agra-Varela (2013) suggest that online
training is preferable over a traditional lecture format, with advantages including, but not
limited to: active learner involvement, flexibility and accessibility, learner satisfaction,
and reduced cost. Research suggests that online learning is an effective, accessible, and
cost effective method of training, which is made more effective when accompanied by an
interactive component, such as: face-to-face interaction, interactive online communities,
and accompanying workbooks.
Purpose for the Present Study

Concussion training programs currently exist in some school districts, but these have not been rigorously examined. Further, no literature on the efficacy of online concussion training modules currently exists. Thus, the purpose of the present study was to evaluate the effectiveness of the Ohio Department of Health’s new online concussion training programs.
CHAPTER III

METHOD

Research Questions

This study examined two research questions: 1) what is the effectiveness of online concussion training programs in increasing school professionals’ concussion awareness, knowledge and confidence in concussion identification and response? and 2) what is the effectiveness of online concussion training programs in increasing participants’ ability to apply skills in relation to concussion recognition and response?

It was hypothesized that the online concussion training programs would increase concussion awareness, knowledge, and confidence in concussion identification and response in school professionals. Additionally, it was hypothesized that the programs would increase participants’ skills in concussion recognition and response, specifically when applied to concussion case examples. These hypotheses are supported by research suggesting that concussion educational and training interventions can increase concussion awareness, knowledge, recognition, and response in school professionals (Covassin, Elbin, & Sarmiento, 2012).
**Research Design**

This study utilized Snyder’s (2010) mixed-methods approach; the primary researcher collected both quantitative and qualitative data to determine the effectiveness of the ODH concussion Teacher and Team training online modules.

**Participants and Setting**

Convenience sampling was used to recruit participants from 4 school districts in Ohio, yielding approximately \( n = 30 \) participants for the Teacher Training (see Table 1), and \( n = 11 \) participants for the Team Training (see Table 2). School professionals were recruited through a partnership with the Ohio Department of Health (ODH), which funded the development of concussion training programs to be implemented in interested school districts in the state of Ohio. School professionals were also recruited through the researcher’s graduate assistantship, through which she works with principals, as well as through the researcher’s internship placement in an Ohio school district. Additionally, the online trainings are openly available on the ODH’s website, therefore, due to the anonymity of submitting responses to the training, school professionals from various districts throughout Ohio may have taken the training. See Table 1 for participant demographic information.
Table 1

*Participant Demographic Data, Teacher Training*

<table>
<thead>
<tr>
<th>Demographic</th>
<th>N</th>
<th>Percentage</th>
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<tbody>
<tr>
<td><strong>Position</strong></td>
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<tr>
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<td>School Psychologist</td>
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<tr>
<td>Nurse</td>
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<td>7%</td>
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<tr>
<td>Intervention Specialist</td>
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<td>3%</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>1-5</td>
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<tr>
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<tr>
<td>Other</td>
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<td><strong>Prior Concussion Training</strong></td>
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<tr>
<td>Yes</td>
<td>11</td>
<td>37%</td>
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</table>
No 19  63%

Past Experience with Concussion Response and Recognition

Yes 13  43%
No 17  57%

Table 2

Participant Demographic Data, Team Training

<table>
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<tr>
<th>Demographic</th>
<th>N</th>
<th>Percentage</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>Teacher</td>
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<tr>
<td>Administrator</td>
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<tr>
<td>Paraprofessional</td>
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<td>9%</td>
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<tr>
<td>Intervention Specialist</td>
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<td>9%</td>
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<tr>
<td>Nurse</td>
<td>3</td>
<td>28%</td>
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<td>Athletic Coach</td>
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<td>9%</td>
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<tr>
<td>Occupational Therapist</td>
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<td>9%</td>
</tr>
<tr>
<td>Sports Official</td>
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<td>18%</td>
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Number of Years in Education

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<td>9%</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>18%</td>
</tr>
</tbody>
</table>
20+ 2 18%
No Response 4 37%

Setting
Rural 3 27%
Urban 5 46%
Suburban 3 27%

Prior Concussion Training
Yes 4 37%
No 7 63%

Past Experience with Concussion Response and Recognition
Yes 4 37%
No 7 63%

Materials

Training materials. Participants engaged in either a seventy five minute online audio-visual training module, entitled, Ohio Return to Learn Concussion Team Model, designed for the development of a concussion team, to be delivered to a range of school professionals (e.g., administrators, school psychologists, teachers, nurses), or a thirty minute online audio-visual training module, entitled, Teacher Training, Ohio Return to Learn Concussion Team Model, to be delivered to classroom teachers, intervention specialists, and instructional aides. The Team Training includes a manual, which is available to all participants. Both modules consist of materials and information synthesized from other commercially available concussion training programs, including
the CDC’s Heads Up program (2007), Nationwide Children’s Hospital’s Concussion Clinic Resources for Education (2012), BrainSTEPS (2015), and Colorado Department of Education’s Concussion Management Guidelines (2014). The presenter in the ODH online training audio-visual modules is Dr. Susan Davies (who also serves as chair of this thesis project). Participants were guided by their building principal regarding which training to take. Information covered in the Ohio Return to Learn Concussion Team Model training video includes concussion signs and symptoms, concussion identification and immediate response, return-to-learn and return-to-play protocol, the Concussion Team Model, and accommodations for students who have sustained concussion. The training module has three main objectives, which include:

1. To provide information on how concussions can affect students’ learning, health, and social-emotional functioning.
2. To provide tips on “return to learn,” including tools for assessment, intervention, and progress-monitoring.
3. To provide a suggested concussion team model that involves a designated leader, as well as collaboration among the family, medical personnel, and school team.

The electronic support manual includes “fact sheets” relating to concussion identification and response, and classroom accommodations for teachers. The manual also contains detailed descriptions and responsibilities of Concussion Team members, as well as an overview of the information covered in the online audio-visual module. Support manual and additional resources related to the trainings can be found at:
The Teacher Training, Ohio Return to Learn Concussion Team Model training video includes concussion signs and symptoms, concussion identification and immediate response, return-to-learn and return-to-play protocol, a brief introduction to the Concussion Team Model, and accommodations for students who have sustained concussion. Much of the material in the Teacher Training is the same as the Team Training, however, with less emphasis and detail pertaining to the Concussion Team Model. The Teacher Training module has three main objectives, which include:

1. To provide information on how concussions can affect students’ learning, health, and social-emotional functioning.
2. To provide information about “return to learn” and why it is important to student recovery.
3. To provide strategies for helping students recover from concussion, including classroom tips.

The principal of each school that agreed to participate chose three to eight school professionals to take the Ohio Return to Learn Concussion Team Model, and were given the option to choose or openly invite teachers to take the Teacher Training, Ohio Return to Learn Concussion Team Model. Other participants recruited through ODH’s online availability independently chose which training to participate in.

**Measures.** Pre- and post-tests (see Appendix B) measured participants’ concussion awareness, knowledge, and confidence in concussion response and
prevention, as well as participants’ skill application related to concussion response and prevention. Pre- and post-tests were created by the researcher with consideration to the alignment of the tests with the online training module. The pre- and post- tests consisted of demographic questions (e.g., *What past experience do you have with concussion? What is your role within the school? How many years have you been involved in education?*), as well as multiple choice and true and false questions related to concussion knowledge and confidence in recognition and response. The tests included one question requiring short response to a concussion case scenario and nine questions regarding the perceived effectiveness of the training at improving the participants’ ability to apply skills in concussion recognition and response in schools. The tests were administered via Google Forms. The pre-test was available to participants before and the post-test after completion of the online training modules. On both training modules, the pre-test included five identical demographic questions, with the remaining ten questions nearly identical on both pre- and post-tests, however, the Team training included an additional short response question; the Teacher Training did not.

**Procedures**

The researcher received approval from the Institutional Review Board (IRB) at the University of Dayton to complete this study prior to data collection. The pre- and post-tests were piloted with a group of five school psychology graduate students and two teachers to identify any misleading or confusing questions, as well as to identify any missing parts to the tests. The trainings were piloted in-person by Dr. Susan Davies throughout the 2015-2016 school year with four Ohio School districts. Feedback on the
trainings was obtained through interviews conducted by the researcher, and the trainings were modified accordingly.

The researcher utilized convenience sampling for recruitment by contacting principals of Ohio schools through a partnership with ODH, and the researcher’s graduate assistantship and internship placement. Several principals agreed to endorse the program and encourage their staff to take the trainings. The researcher consulted with principals over email regarding strategies for distributing the program to their staff. Additionally, the trainings are available to the public on ODH’s website, therefore, some participants may have directly participated in the training independently through the site without recruitment from the researcher.
CHAPTER IV

RESULTS

Research Question 1

What is the effectiveness of online concussion training programs in increasing school professionals’ concussion awareness, knowledge and confidence in concussion identification and response? To answer research question 1, participants’ pre-test questionnaire data from the Team and Teacher Trainings were analyzed using the Statistical Package of the Social Sciences (SPSS). Scaled data from pre- and post- tests were utilized to determine participants’ level of awareness, knowledge and confidence in concussion identification and response form pre- to post-test.

Paired-sample t-tests were conducted to evaluate differences in means on the pre-test and post-test means; A level of \( p = .05 \) was used to determine if the means between pre-and post-test scores differ significantly. Results from the pre- and post- tests indicate significant growth in: 1) confidence in concussion recognition response on the Teacher Training (\( p = < .001 \)) and on the Team Training (\( p = .007 \)) and 2) confidence in concussion response team membership on the Teacher Training (\( p = < .001 \)) and on the Team Training (\( p = .021 \)). Results from pre- and post- test questions measuring knowledge and awareness of concussion yielded mixed results. On the teacher training, only one of three questions
measuring knowledge and awareness was significantly different \((p=.032)\), while the other two questions were not \((p=.103 \text{ and } p=.662)\). Similarly, only one of three questions measuring knowledge and awareness was significantly different on the Team Training \((p=.001)\). The remaining two Team Training questions measuring concussion recognition could not be calculated in SPSS, because the standard error of the difference was 0.

Participants in the Team Training also answered a short-response question pertaining to their role on a school-based concussion response team. The average word count for response to this question was 11.45 on the pre-test and 19 on the post-test, and many post-test responses included greater depth and use of vocabulary from the training. One participant’s response on the pre-test consisted of the following: ‘As a nurse, evaluates the student, communication between teachers, parents, healthcare is carried out.’ and on the post-test, the same participant included more detail: ‘As a nurse, I would check doctor’s orders, communicate with educators, principal, parents, and healthcare staff. Make sure that the student is getting the rest he or she needs for the concussion to heal. Be an advocate for the student’s healthcare and educational needs.’

**Research Question 2**

*What is the effectiveness of an online concussion training program in increasing participants’ ability to apply skills in relation to concussion recognition and response?*

To answer research question 2, data from pre- to post-tests were also analyzed using the Statistical Package of the Social Sciences (SPSS). The researcher conducted multiple paired-sample t-tests to determine the effectiveness of the online concussion training programs on participants’ ability to apply skills in relation to concussion recognition and recognition.
response. In addition to the paired-sample t-tests, the researcher also analyzed qualitative data from pre- and post-test by interpreting the content and depth of short-response questions. Specifically, the researcher looked for terminology from the trainings on post-test short-responses, as well as the depth of response on skill application questions from pre- to post-tests.

Paired-sample t-tests were conducted to evaluate whether the mean pre-test ratings were significantly different than the mean post-test ratings. Only one of three questions measuring skill application yielded significant results on the Teacher Training (\(p=.043\)), while the other two did not (\(p=1.84\), and \(p=.161\)). However, the mean word count on the short response on the teacher training pre-test regarding concussion response was significantly different when compared with the Teacher Training post-test (\(p=.030\)), but not on the Team Training post-test (\(p=.347\)). None of the results from the Team Training were significant in relation to this research question (\(p=.341, p=.341, p=.341, p=.347\)).

The short-response question on both trainings required participants to demonstrate knowledge related to applying concussion response and recognition skills to a case scenario. The average word count for response to this question was 10.36 on the pre-test and 13 on the post-test among Team Training responses, and was 18 pre-test, and 25 post-test among Teacher Training responses. Many of the post-test responses included specific vocabulary words, accommodations, and highlighted key themes utilized in the training, such as: “...(the) Teacher should make adjustments, such as shortening assignments, excusing student from assignments, providing breaks, allowing student to study or work in quiet setting, etc.
CHAPTER V
DISCUSSION

Review of Purpose and Major Findings

The purpose of this study was to: 1) evaluate the effectiveness of online concussion training programs in increasing school professionals’ concussion awareness, knowledge and confidence in concussion identification and response, and 2) to evaluate the effectiveness of online concussion training programs in increasing participants’ ability to apply skills in relation to concussion recognition and response.

Interpretation of Major Findings

Research question 1. Results from the pre- and post-test data indicate that both the Teacher and Team online trainings yielded results that were significantly different in the measurement of confidence in concussion identification and response. Additionally, the word count on a short-response question regarding Team Training participants’ role in a concussion response team increased from an average word count of 11.45 on the pre-test to 19 on the post-test, suggesting a greater confidence and knowledge of participant roles and responsibilities post-training. Post-test short-responses also included greater depth and use of vocabulary from the training when compared with pre-test responses. Themes in responses to this question on the post-test included: Monitoring and assessing
symptoms, supporting students, communication, and implementing modifications. Only two of the aforementioned themes were mentioned by participants in the pre-test, and also when mentioned, included less-detail than the post-test responses.

Three questions measuring knowledge and awareness of concussion were included in both trainings, and in both trainings, only one of the questions yielded significant results (Teacher: \( p = .032 \), Team: \( p = .001 \)). It is hypothesized that the two questions that were not significant were either common knowledge (e.g., a concussion only occurs when a person “blacks out”) participants already knew, or the questions were worded poorly, therefore, were unsuccessful in measuring efficacy of the trainings.

**Research question 2.** When comparing means for the multiple choice pre- and post-test questions for both online concussion training programs in relation to concussion recognition and response, results were largely insignificant. One of the three questions on the Teacher Training, which measured recognition and response, was significant \( (p=0.43) \), however, the remaining questions on the Teacher Training, and all questions on the Team Training yielded insignificant results. It is hypothesized that this is largely due to educators’ existing knowledge, as well as the possibility of too many multiple choice options that were not necessarily disproven through the online training programs (e.g., nosebleeds and back pain). Additionally, participants in the Team Training were chosen to take the training in order to play a role on the concussion response team at their school, therefore, existing knowledge and experience may be assumed by participants who chose to take on significant responsibility related to concussion response in their school system.

A significant difference was found in the word-count of the Teacher Training short-response question, which required participants to demonstrate knowledge related to
applying concussion response and recognition skills to a scenario case ($p=.30$). Themes in responses to this question on the post-test included: Communicating with the concussion team, creating adjustments in the student’s schedule and allowing breaks, and reducing noise. Referring students to the nurse and sending students home were the main themes in the pre-test, indicating a significant improvement after participating in the training. Though pre- and post- team responses to this question on the Team Training were not statistically significant, more appropriate themes were also apparent on the post-test compared to the pre-test. Primary themes on the pre-test included: contacting the student’s parents and the school nurse, and allowing the student to take breaks. Primary themes in the post-test included: Communicating with the team (contacting Concussion Team Leader), planning academic adjustments, and allowing for rest.

**Limitations**

Several limitations are apparent in this study, which affect the generalizability and implications of the findings. Though participants were made aware that their pre- and post-test responses remain anonymous, there is a possibility of bias among participants. Participants may have been inclined to report higher rates of confidence in concussion awareness and response post-training due to perceived pressure from their employer to be more competent in concussion awareness and response post-training. Online administration also represents a limitation of this study, as it cannot be positively determined that the participants completed the training alone, without any help from another person, or other online resources.

This study did not have a control group, which is a significant limitation. Additionally, this study included a relatively small sample size, with the Teacher
Training \((n=30)\) and Team Training \((n=11)\), suggesting that results should be interpreted with caution.

**Implications for Future Research**

Future research to build upon the findings of this design may benefit from adjusting or creating more reliable measures of concussion knowledge that include less multiple choice options. The multiple choice options, which measured concussion signs and symptoms, included multiple correct answers, therefore, if participants included non-correct answers, they did not receive credit. To resolve this, it may be more appropriate to create multiple choice questions with several symptoms included in each choice, but only one array of symptoms can be chosen as the correct answer.

**Conclusion**

Online concussion training programs utilized in this study have shown to be effective in increasing concussion identification and response (Teacher: \(p=0.43\)), knowledge and awareness of concussion (Teacher: \(p=.032\), Team: \(p=.001\)), and confidence in concussion team membership (Teacher: \(p=<.001\), Team: \(p=.021\)). Additionally, the online Teacher training program increased the depth of knowledge in concussion response, and through qualitative data analysis, both trainings increased depth of knowledge in concussion skill application. The present study supports the notion that online concussion training programs are effective in increasing concussion identification, response, knowledge, and awareness (Covassin, Elbin, & Sarmiento, 2012). Online training programs are easily accessible, and these specific ODH online concussion trainings are also free, which allows them to be easily accessed and utilized in school systems, confirming the benefits of online training programs suggested in Pelayo-
Alvarex, Perez-Hoyos, and Agra-Varela’s (2013) study. Results from this study indicate the success and effectiveness of the ODH online concussion training programs in improving concussion response in schools, and will likely positively impact many students who sustain concussion throughout Ohio schools.
REFERENCES


Colvin, J. D., Thurm, C., Pate, B. M., Newland, J. G., Hall, M., & Meehan III, W. P. (2013). Diagnosis and acute management of patients with concussion at children's hospitals. *Archives of Disease in Childhood*, 98(12), 934-938. doi:10.1136/archdischild-2012-303588


http://www.nationwidechildrens.org/concussions-in-the-classroom


Email to invite participants:

Dear principal,

As a school psychology graduate student, I work with Dr. Susan Davies at the University of Dayton on projects related to improving concussion recognition and response in schools. School-aged children (5-18) are at an increased risk of sustaining concussions, which can significantly affect students, academically and physically, particularly if symptoms are not managed appropriately. To help alleviate this problem, we are distributing two free online concussion-training programs for school professionals in Ohio:

1) The *Ohio Return to Learn Concussion Team Model* is an in-depth training to develop a Concussion Response Team. (approx 75 minutes)

2) The *Teacher Training, Ohio Return to Learn Concussion Team Model*, which is a more brief training for teachers to improve their recognition and response to concussion. (approx 30 min)

These trainings were developed with the support of the Ohio Department of Health; their development is supported by the Ohio High School Athletic Association, the Ohio School Psychology Association, the Ohio Department of Education Office of Exceptional Children. At the end of the training, participants can receive a certificate of participation that can provide documentation of their professional development.

If you would like to learn more about this project, and may be interested in participating (either in May, throughout the summer, or in the Fall), please respond to this email, call me, at *(513) 328-4700*, or email me at *tedescom2@udayton.edu*.

Thank you for your interest and time,

Maria
Dear Principal,

My name is Maria Tedesco. As a school psychology graduate student, I work with Dr. Susan Davies at the University of Dayton on projects related to improving concussion recognition and response in schools. I would like to invite you and your school to participate in a project that provides free training and resources to educators on recognition and response to concussions in schools.

School-aged children (5-18) are at an increased risk of sustaining concussions, which can significantly affect students, academically and physically, particularly if symptoms are not managed appropriately. To help alleviate this problem, we are distributing two free online concussion-training programs for school professionals in Ohio:

1) The Ohio Return to Learn Concussion Team Model is an in-depth training to develop a Concussion Response Team. (approx 1 hour and 15 min)

2) The Teacher Training, Ohio Return to Learn Concussion Team Model, which is a more brief training for teachers to improve their recognition and response to concussion. (approx 30 min)

These trainings were developed with the support of the Ohio Department of Health; their development is supported by the Ohio High School Athletic Association, the Ohio School Psychology Association, the Ohio Department of Education Office of Exceptional Children. At the end of the training, participants can receive a certificate of participation that can provide documentation of their professional development.

**WHAT IS THE PURPOSE OF THE STUDY?**

The purpose of this study is to investigate the effectiveness of an online concussion training program on school professionals’ recognition and response to student concussion.

**WHAT WILL BE DONE IN THIS STUDY?**

This project involves two online training audio-visual modules, one which is approximately one hour and fifteen minutes, which is to be administered to suggested members of a Concussion Team (school nurse, school counselor, school psychologist, athletic trainer, principal, etc.) and will be accompanied by a support manual. The other online training audio-visual module is thirty minutes, which is to be administered to
teachers. The modules consist of materials and information synthesized from pre-existing concussion training programs, including the CDC’s Heads Up program (2007), Nationwide Children’s Hospital’s Concussion Clinic Resources for Education (2012), BrainSTEPS (2015), and Colorado Department of Education’s Concussion Management Guidelines (2014).

The presenter in the ODH online training audio-visual module is Dr. Susan Davies (who also serves as chair of this thesis project). Information covered in the hour and fifteen minute Ohio Return to Learn Concussion Team Model training video includes concussion signs and symptoms, concussion identification and immediate response, return-to-learn and return-to-play protocol, the Concussion Team Model, and accommodations for students who have sustained concussion. The training module has three main objectives, which include:

1. To provide information on how concussions can affect students’ learning, health, and social-emotional functioning.
2. To provide tips on “return to learn,” including tools for assessment, intervention, and progress-monitoring.
3. To provide a suggested concussion team model that involves a designated leader, as well as collaboration among the family, medical personnel, and school team.

The support manual includes “fact sheets” relating to concussion identification and response, and classroom accommodations for teachers. The manual also contains detailed descriptions and responsibilities of Concussion Team members, as well as an overview of the information covered in the online audio-visual module.

The Teacher Training, Ohio Return to Learn Concussion Team Model training video includes more brief concussion signs and symptoms, concussion identification and immediate response, return-to-learn and return-to-play protocol, a brief introduction to the Concussion Team Model, and accommodations for students who have sustained concussion. The training module has three main objectives, which include:

1. To provide information on how concussions can affect students’ learning, health, and social-emotional functioning.
2. To provide information about “return to learn” and why it is so important to student recovery.
3. To provide strategies for helping students recover from concussion, including classroom tips.

If you agree to participate in my study, you will choose school professionals who you feel would be good members of a Concussion Team Model and ask if they would like to participate in the study by taking the Ohio Return to Learn Concussion Team Model
online module. These school professionals can include a range of roles, including, but not limited to: Coaches, Teachers, Nurses, School Counselors, and School Psychologists. You may invite as many school professionals as you feel appropriate. Most Concussion Teams consist of roughly 5-8 school professionals. You may also choose as many teachers as you would like to participate in the Teacher Training, Ohio Return to Learn Concussion Team Model, or, simply open an invitation to all teachers in your school.

After the participants have been identified, I will provide you with a link to the training module, which can be sent to participants. Participants will take a pre-test, watch the module videos, and answer post-test questions throughout. After completion of these steps, if they choose to provide the researcher with their name, participants will be awarded with a “Certificate of Completion”, which will represent their completion of the training.

**ANTICIPATED BENEFITS TO PARTICIPANTS**

There are a number of benefits related to participation in this study. As mentioned previously, students aged 5-18 are at a greater risk of sustaining concussion, and the effects of concussion can affect student learning and health. Effects of concussion worsen when not treated appropriately. This program is hypothesized to increase the recognition and response of concussion in school professionals. The training program teaches participants about concussion signs and symptoms, and how to appropriately transition students who have sustained concussion back into school, including recommended accommodations for varying symptoms.

This program will also likely benefit the students in your school who have sustained, or may sustain a concussion. School professionals in your building will be more informed on concussion recognition and response, and likely will be more effective in transitioning students back into school and providing them with appropriate academic adjustments as they recover after completing this training.

**IN CASE OF RESEARCH RELATED ADVERSE EFFECTS**

If you experience any kind of discomfort as a result of your participation in my study, you may contact me (Maria Tedesco) at 513-328-4700, tedescom2@udayton.edu or my thesis advisor, Dr. Susan Davies at 937-229-3652, sdavies1@udayton.edu.

**CONFIDENTIALITY**

If results of research from this study are published or discussed in conferences, no identifying information about the school or participants will be included.

**PARTICIPATION AND WITHDRAWAL**

Your participation in this study is voluntary. If you decide to participate, you are able to withdraw your consent and cease participation in my study at any time without
discrimination or penalization. Also the principal investigator may withdraw you from participating in this study if necessary circumstances develop.

IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about this study you may contact: Maria Tedesco, student researcher, University of Dayton, 513-328-4700, tedescom2@udayton.edu or the Principal Investigator, Dr. Susan Davies, University Dayton, 937-229-3652, sdavies1@udayton.edu.

RIGHTS OF RESEARCH PARTICIPANTS

If you have questions regarding your rights as a research participant, you may contact the Chair of the Institutional Review Board (IRB) at the University of Dayton: Candise Powell, J.D., (937) 229-3515, IRB@udayton.edu.

SIGNATURE OF RESEARCH PARTICIPANT (or legal guardian)

I have read the information provided above. I have been given an opportunity to ask questions and all of my questions have been answered to my satisfaction. I have been given a copy of this form. I certify that I am at least 18 years of age.

Name of participant
______________________________________________

Address
____________________________________________________________________

Signature of Participant
________________________________________Date___________

SIGNATURE OF WITNESS

My signature as witness certifies that the Participant signed this consent form in my presence.

Name of Witness (please print)
________________________________________

Signature of Witness _________________________________

Date __________ (Must be same as participant signature date).
APPENDIX B

MEASURES

Pre-Test: Teacher Training

The following training will present information relating to student concussion to improve both concussion recognition and response in Ohio Teachers. This module includes a pre-test, and a 31 minute video with corresponding knowledge questions. The module should take you roughly forty minutes.

By completing the questions involved in this training, you are consenting to participate in a research study on a school-based concussion training through the University of Dayton. Your participation is voluntary, and you can stop at any time for any reason. Your identity will not be attached to this questionnaire.

Please answer the questions to the best of your knowledge, and in the order in which they are presented to you.
Thank you!

1. How many years have you worked in education?
   ____

2. Please indicate your role in the school:
   ___Teacher
   ___Other; Please Indicate: ______________________________

3. Have you ever received formal education about concussion? (seminar, meeting, class, etc..)
   ___Yes
   ___No

4. Do you have any past experience or knowledge with concussion recognition and response?
   ___Yes
   ___No

5. What is the demographic of your school district?
   ___Urban
   ___Rural
   ___Suburban
   ___Other..

6. Please rate your current confidence in concussion recognition and response:
   1 (very little confidence)-2-3-4-5-6-7-8-9-10 (Very confident)
7. Please rate your confidence in your ability to be a part of a school-based concussion team:
   1 (very little confidence)-2-3-4-5-6-7-8-9-10 (Very confident)

8. Which of the following are signs of concussion? Check all that apply.
   ___ Appears dazed or stunned
   ___ Nosebleed
   ___ Sharp burning pain in neck and shoulders
   ___ Confusion about events
   ___ Chest pain
   ___ Behavior or personality change
   ___ Answers questions slowly

9. Regarding concussions, which statements are true? Check all that apply.
   ___ A concussion can be diagnosed by a CAT scan
   ___ A concussion only occurs when a student is hit directly in the head
   ___ A concussion causes neurochemical changes in the brain
   ___ A concussion is unlikely to affect a student's performance in school
   ___ A concussion only affects students for 24 hours

10. A concussion only occurs if loss of consciousness occurs (“black out”).
    ___ True
    ___ False

11. A student should not be returned to school until completely asymptomatic.
    ___ True
    ___ False

12. Which statement is true for a student in recovery from concussion? Select one answer.
    ___ Academic adjustments should be implemented in the classroom until symptoms are gone
    ___ A student should not return to school until fully recovered
    ___ Return to school and physical activity as usual after 24 hours

13. A student brings you a note from a qualified physician that diagnoses him with a concussion. He
    complains of a headache, dizziness, and trouble remembering things. Regarding school
    attendance, which of the following is likely the best course of action? Select one answer.
    ___ He should be absent from school until his headaches resolve completely
    ___ He should participate fully in school so he doesn’t fall behind in his work
    ___ He may come to school long enough to take any scheduled tests
    ___ He should attempt to attend school and go home or rest if his symptoms worsen with
        cognitive exertion

14. In most cases, when a student is recovering from concussion, in which order should students
    return to learning (school) and return to play (physical activity)? Select one answer.
    ___ Student should first return to learn, and then return to play.
    ___ Student should first return to play, then return to learn.
    ___ Student should return to learn and play at the same time.

15. Christie ran into a teammate at her soccer practice when both players were running for the ball.
    Christie was knocked to the ground from the impact. Christie was diagnosed with concussion and
    returns to school 2 days later. She comes to school tired, moody, and complains about the noise
    level in the classroom. What should the teacher do? Explain below:
Thank you for taking the time to complete the pre-test. Please proceed to the training video and post-test.

**Teacher Training Post-Test:**

1. Please rate your current confidence in concussion recognition and response on a scale of 1-10.  
   1 (very little confidence)-2-3-4-5-6-7-8-9-10 (Very confident)

2. Please rate your confidence in your ability to be a part of a school-based concussion team on a scale of 1-10.  
   1 (very little confidence)-2-3-4-5-6-7-8-9-10 (Very confident)

3. Which of the following are signs of concussion? Check all that apply.  
   ___ Appears dazed or stunned  
   ___ Nosebleed  
   ___ Sharp burning pain in neck and shoulders  
   ___ Confusion about events  
   ___ Chest pain  
   ___ Behavior or personality change  
   ___ Answers questions slowly

4. Regarding concussions, which statements are true? Check all that apply.  
   ___ A concussion can be diagnosed by a CAT scan  
   ___ A concussion only occurs when a student is hit directly in the head  
   ___ A concussion causes neurochemical changes in the brain  
   ___ A concussion is unlikely to affect a student’s performance in school  
   ___ A concussion only affects students for 24 hours

5. A concussion only occurs if loss of consciousness occurs (“black out”).  
   ___ True  
   ___ False

6. A student should not be returned to school until completely asymptomatic.  
   ___ True  
   ___ False

7. Which statement is true for a student in recovery from concussion? Select one answer.  
   ___ Academic adjustments should be implemented in the classroom until symptoms are gone  
   ___ A student should not return to school until fully recovered  
   ___ Return to school and physical activity as usual after 24 hours

8. A student brings you a note from a qualified physician that diagnoses him with a concussion. He complains of a headache, dizziness, and trouble remembering things. Regarding school attendance, which of the following is likely the best course of action? Select one answer.  
   ___ He should be absent from school until his headaches resolve completely  
   ___ He should participate fully in school so he doesn’t fall behind in his work  
   ___ He may come to school long enough to take any scheduled tests  
   ___ He should attempt to attend school and go home or rest if his symptoms worsen with cognitive exertion
9. In most cases, when a student is recovering from concussion, in which order should students return to learning (school) and return to play (physical activity)? Select one answer.
   ___Student should first return to learn, and then return to play.
   ___Student should first return to play, then return to learn.
   ___Student should return to learn and play at the same time.

10. Christie ran into a teammate at her soccer practice when both players were running for the ball. Christie was knocked to the ground from the impact. Christie was diagnosed with concussion and returns to school 2 days later. She comes to school tired, moody, and complains about the noise level in the classroom. What should the teacher do? Explain below:
    
    ____________________________

Thank you for participating! Please contact the following researchers with any questions or concerns:
Maria Tedesco, tedescom2@udayton.edu, (513) 328-4700: Dr. Susan Davies, sdavies1@udayton.edu, (937) 229-3652:

If you feel you have been treated unfairly, or you have questions regarding your rights as a research participant, you may contact Candise Powell, J.D., Chair of the Institutional Review Board at the University of Dayton, IRB@udayton.edu; Phone: (937) 229-3515.

Pre-Test: Team Training

The following training will present information relating to student concussion to improve both concussion recognition and response in Ohio schools. This module includes a pre-test and three videos (two are 20 minutes, the final is 30 minutes) with corresponding post-test knowledge questions. The module should take you roughly an hour and a half.

By completing the questions involved in this training, you are consenting to participate in a research study on a school-based concussion training through the University of Dayton. Your participation is voluntary, and you can stop at any time for any reason. Your identity will not be attached to this questionnaire.

Please answer the questions to the best of your knowledge, and in the order in which they are presented to you.
Thank you!

1. How many years have you worked in education?
   Please indicate: ___

2. Please indicate your role in the school:
   ___Teacher
   ___Nurse
   ___School Counselor
   ___School Psychologist
   ___Paraprofessional
   ___Occupational Therapist
   ___Speech and Language Pathologist
   ___Administrator
3. Have you ever received formal education about concussion? (seminar, meeting, class, etc..)
   ___Yes
   ___No

4. Do you have any past experience or knowledge with concussion recognition and response?
   ___Yes
   ___No

5. What is the demographic of your school district?
   ___Urban
   ___Rural
   ___Suburban
   ___Other...

6. Please rate your current confidence in concussion recognition and response on a scale of 1-10.
   1 (very little confidence)-2-3-4-5-6-7-8-9-10 (Very confident)

7. Please rate your confidence in your ability to be a part of a school-based concussion team on a scale of 1-10.
   1 (very little confidence)-2-3-4-5-6-7-8-9-10 (Very confident)

8. Which of the following are signs of concussion? Check all that apply.
   ___Appears dazed or stunned
   ___Nosebleed
   ___Sharp burning pain in neck and shoulders
   ___Confusion about events
   ___Chest pain
   ___Behavior or personality change
   ___Answers questions slowly

9. Regarding concussions, which statements are true? Check all that apply.
   ___A concussion can be diagnosed by a CAT scan
   ___A concussion only occurs when a student is hit directly in the head
   ___A concussion causes neurochemical changes in the brain
   ___A concussion is unlikely to affect a student’s performance in school
   ___A concussion only affects students for 24 hours

10. A concussion only occurs if loss of consciousness occurs (“black out”).
    ___True
    ___False

11. In most cases, when a student is recovering from concussion, in which order should students return to learning (school) and return to play (physical activity)? Select one answer.
    ___Student should first return to learn, and then return to play
__Student should first return to play, then return to learn
__Student should return to learn and play at the same time

12. Briefly explain what you feel your role(s) would be in a school-based concussion team when a student returns to school with concussion. Your answer may be based on your position (school nurse, administrator, teacher...):

__________________________________________________________________________________

13. Which statement is true for a student in recovery from concussion? Select one answer.

___Academic adjustments should be implemented in the classroom until symptoms are gone
___A student should not return to school until fully recovered
___Return to school and physical activity as usual after 24 hours

14. A student brings you a note from a qualified physician that diagnoses him with a concussion. He complains of a headache, dizziness, and trouble remembering things. Regarding school attendance, which of the following is likely the best course of action? Select one answer.

___He should be absent from school until his headaches resolve completely
___He should participate fully in school so he doesn’t fall behind in his work
___He may come to school long enough to take any scheduled tests
___He should attempt to attend school and go home or rest if his symptoms worsen with cognitive exertion

15. Christie ran into a teammate at her soccer practice when both players were running for the ball. Christie was knocked to the ground from the impact. Christie was diagnosed with concussion and returns to school 2 days later. She comes to school tired, moody, and complains about the noise level in the classroom. What should the teacher do? Explain below:

__________________________________________________________________________________

Thank you for taking the time to complete the pre-test. Please proceed to the training video and post-test.

Post-Test: Team Training

Part 1:

1. Which of the following are signs of concussion? Check all that apply.

___Appears dazed or stunned
___Nosebleed
___Sharp burning pain in neck and shoulders
___Confusion about events
___Chest pain
___Behavior or personality change
___Answers questions slowly

2. Regarding concussions, which statements are true? Check all that apply.

___A concussion can be diagnosed by a CAT scan
___A concussion only occurs when a student is hit directly in the head
___A concussion causes neurochemical changes in the brain
___A concussion is unlikely to affect a student’s performance in school
___A concussion only affects students for 24 hours
3. A concussion only occurs if loss of consciousness occurs (“black out”).
   ___ True
   ___ False

4. In most cases, when a student is recovering from concussion, in which order should students return to learning (school) and return to play (physical activity)? Select one answer.
   ___ Student should first return to learn, and then return to play.
   ___ Student should first return to play, then return to learn.
   ___ Student should return to learn and play at the same time.

   PART 2:

5. Briefly explain what you feel your role(s) would be in a school-based concussion team when a student returns to school with concussion. Your answer may be based on your position (school nurse, administrator, teacher...):
   ____________________________________________________________

   PART 3:

6. Which statement is true for a student in recovery from concussion? Select one answer.
   ___ Academic adjustments should be implemented in the classroom until symptoms are gone
   ___ A student should not return to school until fully recovered
   ___ Return to school and physical activity as usual after 24 hours

7. A student brings you a note from a qualified physician that diagnoses him with a concussion. He complains of a headache, dizziness, and trouble remembering things. Regarding school attendance, which of the following is likely the best course of action? Select one answer.
   ___ He should be absent from school until his headaches resolve completely
   ___ He should participate fully in school so he doesn’t fall behind in his work
   ___ He may come to school long enough to take any scheduled tests
   ___ He should attempt to attend school and go home or rest if his symptoms worsen with cognitive exertion

8. Christie ran into a teammate at her soccer practice when both players were running for the ball. Christie was knocked to the ground from the impact. Christie was diagnosed with concussion and returns to school 2 days later. She comes to school tired, moody, and complains about the noise level in the classroom. What should the teacher do? Explain below:
   ____________________________________________________________________________

9. Please rate your current confidence in concussion recognition and response on a scale of 1-10.
   1 (very little confidence)-2-3-4-5-6-7-8-9-10 (Very confident)

10. Please rate your confidence in your ability to be a part of a school-based concussion team on a scale of 1-10.
    1 (very little confidence)-2-3-4-5-6-7-8-9-10 (Very confident)

   Thank you for participating! Please use the handouts and accompanying manual for future reference in practice. Please contact the following researchers with any questions or concerns: Maria Tedesco, tedescom2@udayton.edu, (513) 328-4700: Dr. Susan Davies, sdavies1@udayton.edu, (937) 229-3652:
If you feel you have been treated unfairly, or you have questions regarding your rights as a research participant, you may contact Candise Powell, J.D., Chair of the Institutional Review Board at the University of Dayton, IRB@udayton.edu; Phone: (937) 229-3515.