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SEVERE WEATHER DECISIONS IN K-12 SCHOOLS: A PROBLEM BASED LEARNING APPROACH

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DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

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Chapter 1: Introduction

The Importance of Severe Weather

Over the past 10 years, severe weather is responsible for an average of 278 fatalities annually in the United States. Additionally within the past year, severe weather has been responsible for seven events each costing over a billion dollars in damage (National Weather Service, 2013c). Severe weather is defined by the National Weather Service as any dangerous meteorological phenomena that have the potential to cause social disruption, damage, or human life (Edwards, Imy, & Liang, 2013). Severe weather phenomena are different in different areas of the country, depending on the latitude. It can include anything from high winds, hail, wildfires, lighting, tornadoes, blizzards, dust storms, tropical cyclones, downburst, and more (National Weather Service, 2009). However in this study I will be looking at how severe weather affects a particular region of the United States, the Great Plains, and focus on two phenomenon. Therefore severe weather throughout this paper will refer specifically to severe thunderstorms and tornadoes.

Severe thunderstorms can consist of damaging winds or derechos, hail, and lightning. Derechos are strong, damaging straight line winds associated with clusters of severe thunderstorms (Ahrens, 2007). For the storm to be considered a derecho it must have wind gusts of at least 58 mph but they can exceed 100 mph (Johns, Evans, & Corfidi, 2013). Large hail is typically associated with severe thunderstorms and derechos. Hail sizes can be anything from the size of a pea to eight inches in diameter which is the largest on record falling near Vivian South Dakota on July 23, 2010

(National Weather Service, 2010). Hail can occur nationwide, Figure 1 shows the national reports of large hail (1 inch or greater in diameter or about the size of a quarter) from the years of 2010, 2011, and 2012 (Storm Prediction Center, 2011a, 2011b, 2013a). Hail has been known to break windows, damage roofs, dent cars, as well as cause extensive damage to livestock or crops (Ahrens, 2007).

Figure 1. Annual Hail Reports

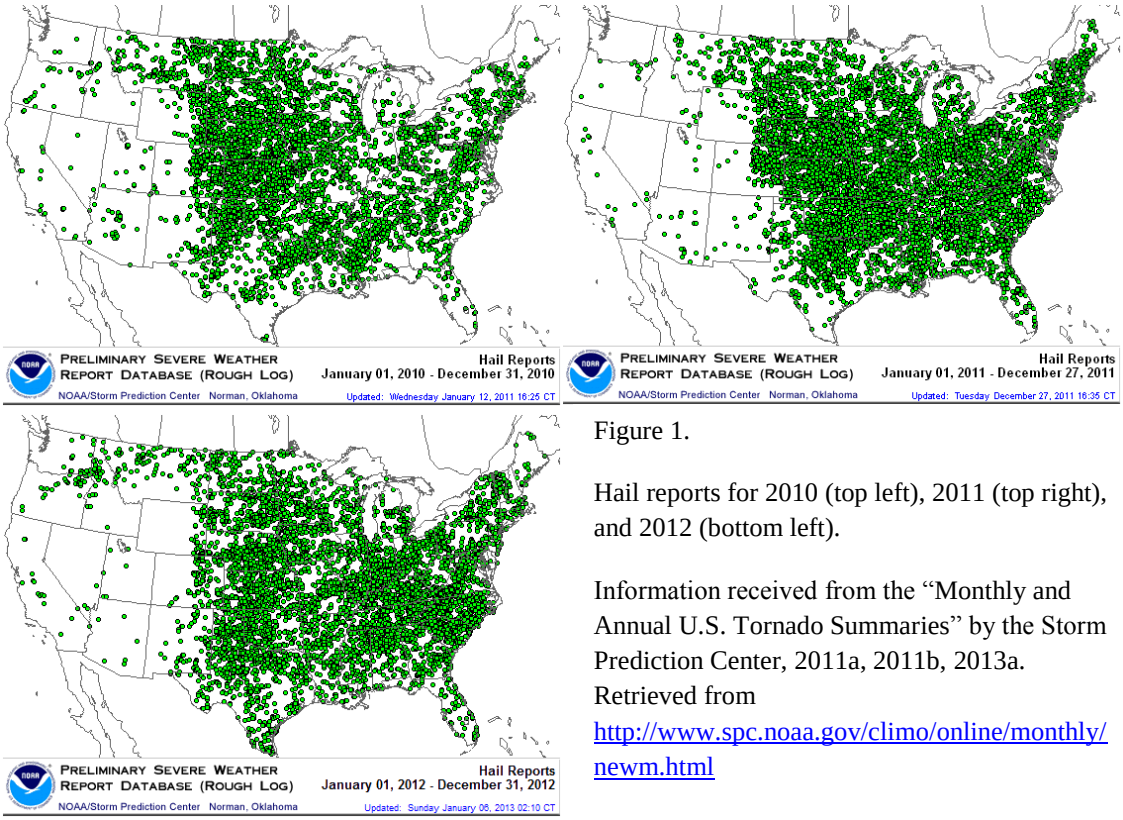

Figure 1.

Hail reports for 2010 (top left), 2011 (top right), and 2012 (bottom left).

Information received from the "Monthly and Annual U.S. Tornado Summaries" by the Storm Prediction Center, 2011a, 2011b, 2013a. Retrieved from http://www.spc.noaa.gov/climo/online/monthly/newm.html

Severe thunderstorms can have watches and warnings issued for them. A severe thunderstorm watch is issued when the atmosphere has the potential to produce hail of one inch diameter or larger and/or have the potential for damaging winds during a three

to eight hour period (Edwards, Imy, & Liang, 2013). A severe thunderstorm warning is issued when the WSR-88D radar, or spotter, reports hail of one inch or larger in diameter or winds exceeding 58 mph. Severe thunderstorm warnings are issued by one of the regional Weather Forecast Offices (WFO) responsible for a specific county warning area. There are 122 WFOs across the United States including Puerto Rico and Guam. Figure 2 shows each WFO and the area they are responsible for (National Weather Service, 2012). Location of the storm, what town will be affected, and the primary threat associated with the storm are all included in the severe thunderstorm warning issued by the local WFO (National Weather Service, 2009).

Figure 2. Weather Forecast Office County Warning Area

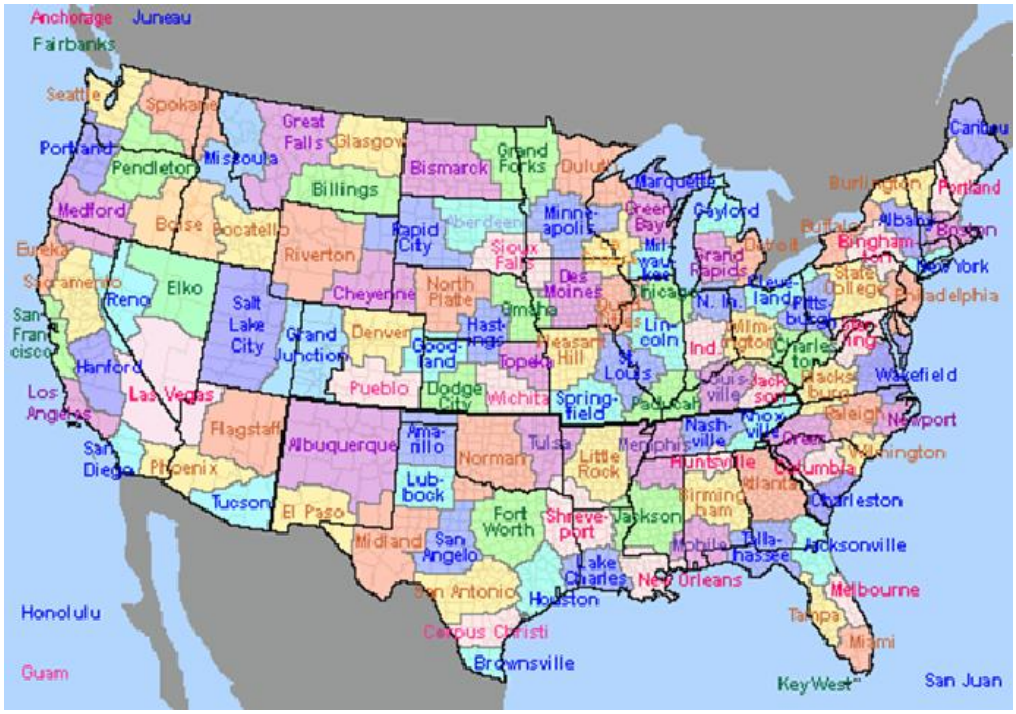

Figure 2: County warning areas for each Weather Forecast Office across the United States. Received from 'JetStream Online School for Weather' by the National Weather Service (2012, Dec 4). Retrieved from http://www.srh.noaa.gov/jetstream/nws/wfos.htm

One of the hazards associated with a severe thunderstorm that does not receive a watch or a warning is lightning. Lightning causes a substantial amount of damage as well as claims many lives each year (Curran, Holle, & López, 2000). Lightning is a phenomenon that occurs in severe thunderstorms which have a severe weather watch, warning, or neither associated with them. This is one of the reasons lightning is particularly dangerous and can be fatal. Lightning fatalities have decreased over the years; however it still proves to be one of the top three fatal storm-related phenomena in the United States (Ashley & Gilson, 2009). In comparison to other thunderstorm-related phenomena, floods are the only type of event to have more average annual fatalities than lightning (Ashley & Ashley, 2008; Ashley & Gilson, 2009; Curran et al., 2000; Rakov & Uman, 2003). From years 2007-2011, there have been a total of 161 lightning fatalities in the United States (National Weather Service, 2013a). These fatalities have occurred in many different locations, victims were doing anything from riding bikes, standing under a tree, boating, and more. In addition to these fatal lightning statistics, there are also hundreds of injuries that occur from lightning each year (Curran et al., 2000). In recent years the use of handheld lightning detection devices has increased by schools and for athletic events. However, the accuracy of determining range of lightning strikes varies greatly with some devices having an efficiency of 36% (DeCaria, Wimer, Fijalkowski, Miziorko, & Limbacher, 2011).

Tornadoes are other phenomena that can occur with severe thunderstorms and these storms also affect many people throughout the United States. A commonly known area occurs in the central US and is known as tornado alley. Figure 3 displays

significant tornado days per century (1921-1995) (National Severe Storms Laboratory, 2003).

Figure 3. Significant Tornado Days

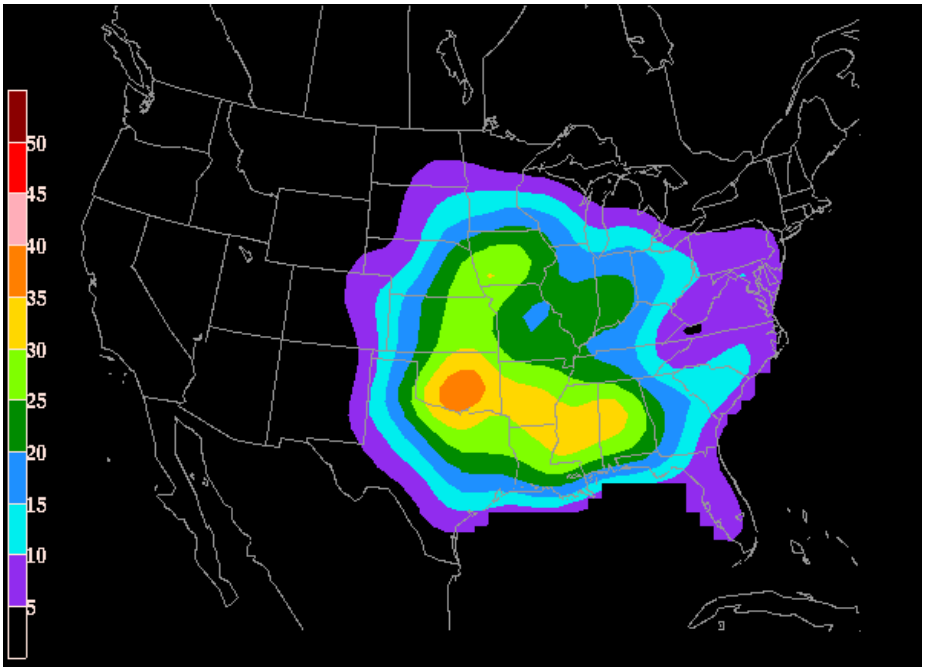

Figure 3.

Significant tornado days per century from 1921-1995. Received from "Severe Thunderstorm Climatology" by the National Severe Storms Laboratory (2003), Retrieved from http://www.nssl.noaa.gov/projects/hazard/totalthreat.html

Typically there are around 1,300 tornadoes reported per year in the United States, give or take a few hundred per year (Ashley, 2007; Edwards, Imy, & Liang, 2013). A three-year average, as of 2012, totals 1,382 tornadoes reported per year in the United States (Storm Prediction Center, 2013a). Tornadoes can occur any time of the year; however tornadoes are more frequent from the months of March through June (Ashley, 2007; Storm Prediction Center, 2013a). Tornadoes are rated by using the

Enhanced Fujita Scale (EF) and are categorized as EF0, EF1, EF2, EF3, EF4, or EF5. The original Fujita scale was named after T. Theodore Fujita with the goal of relating tornado damage to fastest wind in relation to the height of the damaged structure. The problem with the original scale is it was subjective to the damage caused by a tornado and did not take differences of construction into account (Storm Prediction Center, 2011c). For example, a house made of brick and a log cabin house both of the same size will have different damages from the same wind speeds. The EF scale started being used in 2007 (National Weather Service, 2008). The categories are found by estimating the rotational wind speed by estimating damage and wind speeds that can cause that damage. For example, an EF0 might be seen as damage to vegetation and minor damage to roofs or chimneys. Damage from an EF4 tornado would be well-built structures being leveled and heavy vehicles having been tossed into the air. Figure 4 shows tornado occurrences for the years of 2010, 2011, and 2012 (Storm Prediction Center, 2011a, 2011b, 2013a) and Figure 5 shows frequency of the number of tornadoes, number of significant tornadoes (EF2+), and killer tornadoes from 1950-2004 (Ashley, 2007).

Figure 4. Annual Tornado Reports

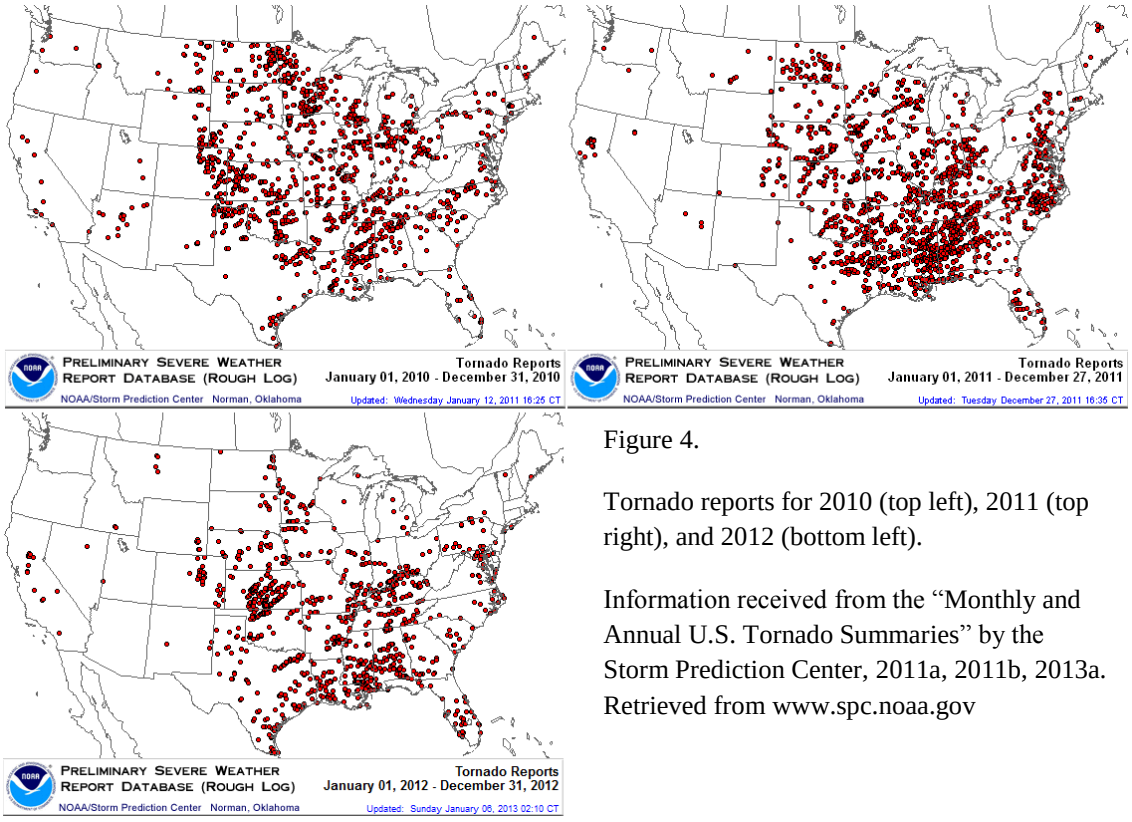

Figure 4.

Tornado reports for 2010 (top left), 2011 (top right), and 2012 (bottom left).

Information received from the "Monthly and Annual U.S. Tornado Summaries" by the Storm Prediction Center, 2011a, 2011b, 2013a. Retrieved from www.spc.noaa.gov

Figure 5. Frequencies of Tornadoes

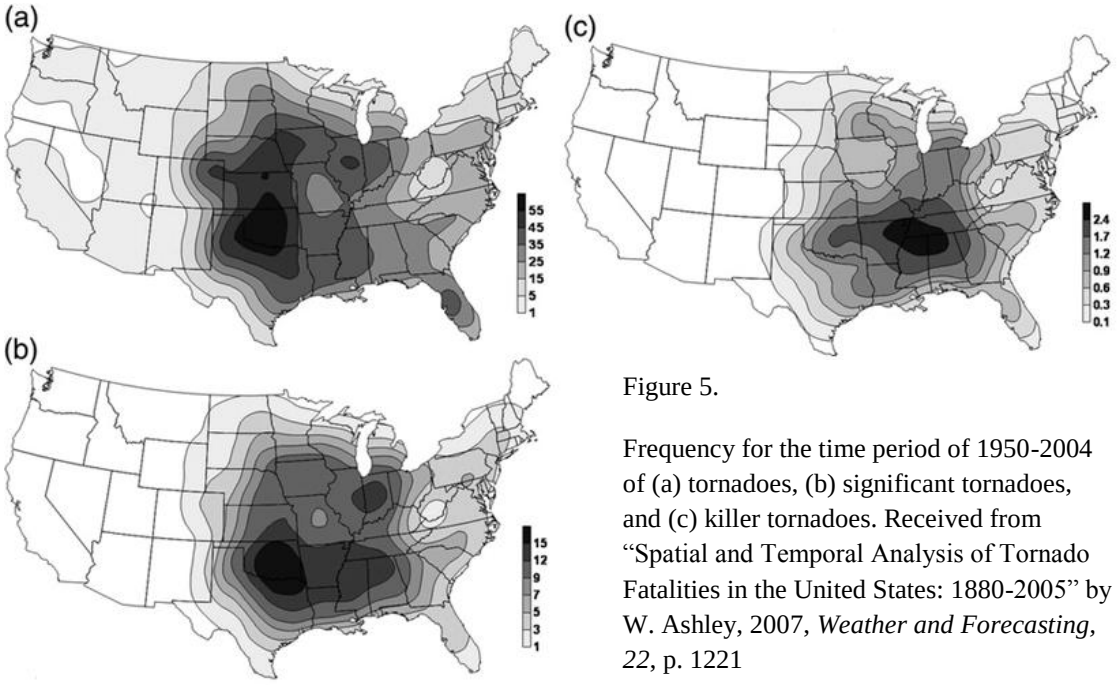

Figure 5.

Frequency for the time period of 1950-2004 of (a) tornadoes, (b) significant tornadoes, and (c) killer tornadoes. Received from "Spatial and Temporal Analysis of Tornado Fatalities in the United States: 1880-2005" by W. Ashley, 2007, *Weather and Forecasting, 22*, p. 1221

Like thunderstorms, tornadoes also can have watches and warnings issued for them. A tornado watch is issued when the atmosphere is capable of producing large hail and damaging wind threats as well as the possibility for multiple tornadoes. Typically watch areas cover about 2,500 square miles. A tornado warning will be issued if a tornado is indicated by the WSR-88D radar or sighted by trained spotters (Edwards, Imy, & Liang, 2013). Tornado warnings can be issued even if there is not a watch in effect and they typically last for around 30 minutes in duration (Edwards, Imy, & Liang, 2013). The length of time from when a tornado warning is issued to when a tornado is reported is considered lead time. Currently the average amount of lead time is 11 minutes (Simmons & Sutter, 2008).

Severe Weather in Oklahoma

One of the states located in tornado alley is Oklahoma. This area will be the primary focus for this study. According to ten year average data, there are about 62 tornadoes reported per year in the state of Oklahoma (Storm Prediction Center, 2013a). Additionally in the past 5 years, there have been 64 fatalities during tornadic events just in the state alone (Storm Prediction Center, 2013b). There have been many tornado outbreaks in the state of Oklahoma, the following information was found from the Storm Prediction Center's (SPC) archived storm reports page (2013a). One of the most famous outbreaks is May 3, 1999. Forty people were killed in Oklahoma by the tornadoes on May 3rd and 4th 1999 with another 675 injured. Some of the places that were affected by these tornadoes were Dover, Shawnee, Perry, Bridge Creek, Moore and the southern Oklahoma City metropolitan area. Amongst the buildings and structures that were hit by these storms, there were seven schools hit: West Moore High School, Bridge Creek Elementary School, Bridge Creek Middle School, Bridge Creek High School, Moore Norman Technology Center, Mulhall/Orlando Elementary School, and Kelley Elementary School. Another outbreak that affected schools occurred on May 10, 2010. 55 tornadoes were documented with two EF-4 tornadoes and 4 EF-3 tornadoes. There were four schools affected by these storms all in the Little Axe area. Another outbreak occurred on May 24th, 2011. Twelve tornadoes were confirmed and one of those was rated an EF-5. The EF-5 tornado swept from Binger to Guthrie destroying many homes and causing at least nine fatalities. Additionally, this outbreak had two tornadoes rated EF-4. In addition to the tornadoes, hail sizes reached at least three inches in diameter also causing a lot of damage. Another outbreak occurred April

13th and 14th, 2012. More than 20 tornadoes touched down in Oklahoma over the two days. The first tornadic activity occurred in Norman on April 13th and touched down at 3:59 pm CDT which was right during the dismissal time of the Norman Public Schools. Additional to this tornado, three and possibly four tornadoes were occurring at one time in a storm near Cooperton during the evening. On April 14th, Woodward had six tornado reports just in their county alone.

The most recent tornado that affected schools happened on May 20th, 2013 hitting Moore, Oklahoma. The tornado was rated an EF-5 and completely destroyed two schools, Plaza Towers Elementary and Briarwood Elementary, with significant damage to a third, Highland East Junior High. The Oklahoma Department of Emergency Management (2013) reported that 23 people were killed, seven of which were students at Plaza Towers Elementary, an estimated 1,150 homes were destroyed, and an estimated $2 billion was recorded in damages. As noted, many people are affected by tornados with significant loss of life and property. However, given the time of day when tornados hit, there are special populations that can be especially vulnerable to injury and death (e.g. hospitals and schools) because of the concentration of people located there. One of these special areas of concern is schools and this will be the focus of this study.

Alert Process

There are many different steps and stakeholders to the alert process as it pertains to severe weather. Stakeholders include the Storm Prediction Center, National Weather Service, emergency managers, schools, hospitals, law enforcement, and other public service personnel. There is a complex communication stream that helps to alert the public of the coming storm.

The Storm Prediction Center's role is to produce convective outlooks, mesoscale discussions, tornado and severe thunderstorm watches, and fire weather outlooks for the entire country. Convective outlooks describe expected areas and intensities for severe weather threats and probabilities for the potential threats. Mesoscale discussions are issued when conditions appear favorable for severe weather and typically occur one to three hours before a watch is issued. A mesoscale discussion will describe what is currently happening as well as what is expected to happen within the next few hours. Tornado and severe thunderstorm watches are issued when conditions are favorable for severe thunderstorms or tornadoes. Fire-weather outlooks are much the same as convective outlooks. They are used to provide fire weather guidance (Novy, Edwards, Imy, & Goss, 2010). The information provided by the SPC are available to the public, however the products produced are typically used by the National Weather Service, emergency managers, private meteorology companies, or others trained on how to read the information provided.

The next step or stakeholder in the alert process is the National Weather Service. The goals of the National Weather Service are to provide weather, water, and climate data to the public. As mentioned earlier, there are 122 local Weather Forecast Offices each responsible for a specific region of the United States. Each office issues the severe weather warnings and seven-day forecast for every location in the area they are responsible for within the United States, Puerto Rico, and Guam (National Weather Service, 2012). From this point stakeholders can be anyone from the local media, emergency managers, law enforcement, and even the general public. Because

emergency managers interact directly with schools, I am going to focus on the emergency mangers and their responsibilities.

An emergency manager is a professional who deals with applying science, technology, planning, and management dealing with events that can hurt people, kill people, and do extensive damage to property (Drabek & Hoetmer, 1991). The emergency manager for a community can be a specific job title (typically urban areas), an added duty to a fire or police chief, or just a volunteer from the local community (typically rural areas). The area an emergency manager covers also is different from area to area. Some emergency managers are responsible for an entire county and some just for a city or town. For example, in Oklahoma, Cleveland County has an emergency manager, but there is also an emergency manager for the city of Moore and the city of Norman both of which are located in Cleveland County. Emergency management has a broad set of functions. The emergency manager's roles are mitigation to prevent or lessen impact of disaster, preparedness such as emergency planning or training, response activities such as conduct search and rescue, and recovery usually meaning restoration of lifelines and services for all disasters that can happen to their town, city, or county (League et al., 2010; Petak, 1985; Waugh & Streib 2006).

One avenue that emergency managers in Oklahoma have available to them for training is a program called OK-First. OK-First is an outreach program provided by the Oklahoma Mesonet with the mission to help Oklahoma's public safety officials (emergency managers and law enforcement) make more educated and quicker decisions during weather situations (OK-First, 2013). OK-First has been in existence since 1996 and has trained more than 500 public safety officials in and around the state of

Oklahoma. By participating in the training program, OK-First participants gain access to real-time weather data from a variety of platforms (e.g. radar, lightning data, and computer model outputs) not available to the general public. Additionally they receive training on how to interpret these different weather platforms (OK-First, 2013). Participants first attend a week-long certification course and thereafter must attend a re-certification course every 18 months. This training is not officially available to school personnel but instead those that report to them. However, in the past couple of years, there have been more school personnel interest and a few have participated each year in the program.

Emergency managers are a critical link to disseminating any information to the special populations that would be located in their jurisdiction (League et al., 2010). Special populations, as noted earlier, can be any place where there are large amounts of people in one area, or an area where it may take longer to move persons to safety in the event that a disaster would happen (e.g. schools, hospitals, nursing homes, large business districts). The emergency managers would disseminate information that they receive from the National Weather Service to law enforcement, hospitals, schools, and other public service officials to help them prepare for the severe weather about to or currently occurring. One issue that comes with this chain of communication from the National Weather Service to the emergency managers to their stakeholders is a built-in delay. The following is a sequence of processes that describes people's responses to warnings. First one must hear the warning (from whoever their source is), they then must understand the contents of the warning, believe the warning is credible and accurate, personalize the warning to oneself, confirm the warning is true, and finally

they must respond by taking a protective action to the warning (Mileti & Sorensen, 1990; Schumacher et al., 2010; Sorensen, 2000). Although there are many special populations that emergency managers contact, this study will focus specifically on the special population of schools.

Schools in Severe Weather

Research has shown there is no clear cut information dissemination process when it comes to alerting school personnel about the possibility for severe weather on any given day. Many studies have shown that initial sources of warning information tend to vary among different sources (Hammer & Schmidlin, 2002; Schumacher et al., 2010). Schumacher et al. (2010) showed that some decision makers do not receive the warning information directly, but rather are waiting on others to communicate it to them. An example cited in their study was a teacher who was unaware of the storm until she heard an announcement over the school's intercom system. The announcement stated a code word that was predetermined by the administration to be used to indicate the announcement was related to weather; however the code was set up to be used for any weather information so it was unclear as to the actual type of weather threat.

To better understand how the communication delay process relates to schools, an example situation would be as follows. Typically two to three days prior to a hazardous weather event the media will be talking about the possibility for severe weather. On the day of the event, the school superintendent might receive a phone call or e-mail from the local emergency manager indicating that there is a warning for their area, while also having the television on receiving information from the local media.

The superintendent must then understand what the warning means and decide if they feel the emergency manager and/or local television is giving them credible information. Once they decide the credibility of the information, they will need to apply it to their school district and personalize it. Depending on the time of day at school, there could be field trips in other locations, sports teams on fields, or buses enroute taking kids to or from schools at the same time. Then the superintendent must confirm the warning whether it is reliable or not, and take protective action for their district and start implementing their safety plans, provided they have one. This is just the process and associated delays that would occur at a school. This same decision making process occurs for each level of the communication chain so it is easy to see how there is a built in delay to the communication process. Figure 6 shows a concept map showing the complexity and many decision points within the communication chain. The blue bubbles with red arrows are the focus of the current study with the grey bubbles and arrows showing the other decision maker stakeholders that also receive the information.

Figure 6. Weather Information Dissemination Chain

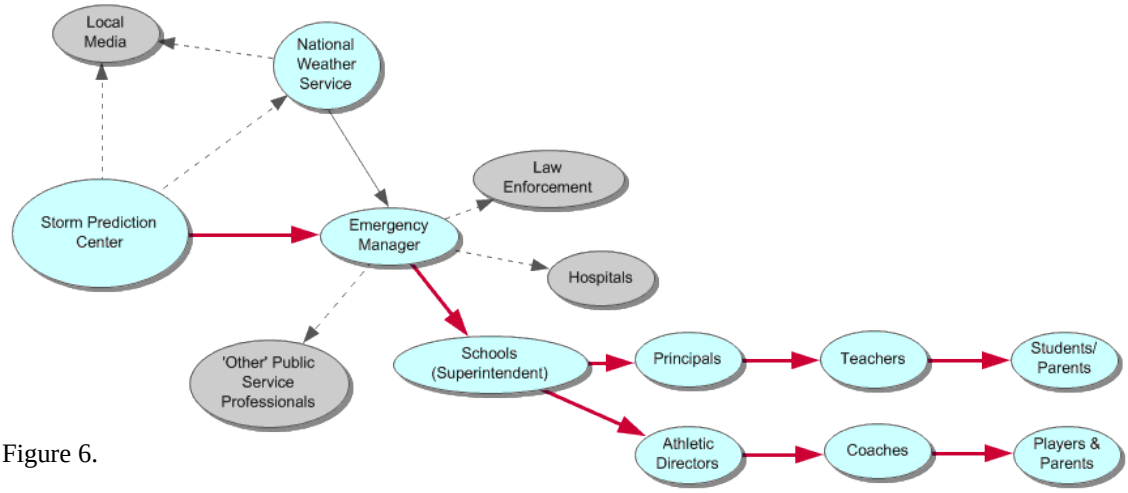

Figure 6.

Concept map of weather information communication chain through all of the stakeholders in severe weather decision making.

School Decision Making Process

There is not much literature on how decisions are made by school superintendents about tornadoes and thunderstorms. Instead, most literature focuses on the decisions that superintendents must make about closing school in snowstorms and hurricanes (Deck & Linton, 2011; Dewar, 2003; Dice & Friedrick, 2012; DeBruin, 2010; Trotter 1988). While the decisions differ on whether students are already at school or not, the decision process and stakeholder constraints are similar. When it comes down to the final decision about whether to postpone school, send students home early, or completely cancel school, the decision is left to the district superintendent. However, less research is known about how and why school administration close schools (Call & Coleman, 2012). Interviews conducted with various administration personnel conclude that there is no 'right' answer of whether to close schools or not (Deck & Linton, 2011; Dice & Friedrick, 2012; Trotter 1988). If the decision to close school is too late then administrators have parents calling and complaining because they have no child care plans for during the day, if the decision is made too early, the weather could change enough to where it would have been okay to keep school open (Trotter, 1988). The decision to close schools also affects the public. Some schools are considered public shelters for severe weather so if the school is closed the public who normally goes to shelter will not be able to get in.

A variety of factors contribute to why an administrator decides to close school. The most important reason cited in the literature is student safety (Call & Coleman, 2012; DeBruin, 2010). This safety is also influenced by some political factors that contribute to this decision. For example, there are educational standards that schools

have to meet each year as far as how many days of school there are each year (Call & Coleman, 2012; Deck & Linton, 2011). Cancelling school can require the school year to be lengthened or vacation days to be cancelled, both unpopular decisions with teachers, parents, and students.

In addition, differing information sources can make the superintendent's decision process more difficult. Preliminary survey results show that the primary sources of information in regards to making decisions during severe weather are the NOAA Weather Radio and the outdoor warning systems (sirens) (Oklahoma Climatological Survey, 2012). Schumacher et al. (2010) also state that anecdotal information for example parents calling, also is used. However, this can introduce false information and contradicting stories which the decision maker will have to sort out before making their final decision which adds to the time delay. Superintendents or school decision makers have to make an impossible decision when it comes to weather related school closing decisions.

In the case of severe weather, closing a school is not the real question. Often severe weather is predicted but does not materialize until the students are in school. For example, the Norman Oklahoma 2012 tornado hit at school dismissal time and after some students were already on buses. The issue was not whether to close school but instead to release students or not. This is also the case when making decisions before or during school sporting events. Unlike winter weather, severe weather can develop very quickly and on the meteorological side, prediction of exact area of development is impossible. School decision makers are forced to make decisions that affect a large

amount of people while also having to take amount of time to get everyone home if the decision is to let students leave, or decide how long to keep people at schools.

Contribution of this Study and Research Questions

Severe weather happens every year across the country causing many injuries and deaths per year. On average, the United States has 25 million lightning flashes a year and 1,300 tornadoes reported each year (National Weather Service, 2013b). Of the 1,300 tornado reports, on average 60 of them come from the state of Oklahoma, which is located in tornado alley (National Severe Storms Laboratory, 2003). There have also been deadly tornado outbreaks in the state of Oklahoma with one of the most famous on May 3rd, 1999, killing 40 people and injuring another 675. There were seven schools hit during the May 3rd outbreak: West Moore High School, Bridge Creek Elementary School, Bridge Creek Middle Schools, Bridge Creek High School, Moore Norman Technology Center, Mullhall/Orlando Elementary School, and Kelley Elementary School. The most recent event that affected schools in Oklahoma was and EF-5 tornado that affected Moore, Oklahoma on May 20th, 2013. This tornado directly affected three schools with Plaza Towers Elementary School and Briarwood Elementary School completely destroyed and Highland East Junior High sustained major damage.

Schools are one of the special populations where administrators have to make decisions with sometimes limited information, limited time, but that affect many people. As of June, 2013 the State of Oklahoma is requiring schools to annually submit a written plan and procedures for natural disasters in regards to safety of their students, faculty, administrations, and visitors (S. Rep. No. 258, 2013). Currently, the only

training available for schools is training on hazardous weather preparedness plans which focuses on what to put into an emergency supply kit or common 'themes' to cover in your plan (e.g. evacuation routes or shelter areas). Additionally, the top administrator journals have been searched for literature on how to best train school decision makers for severe weather related decisions. No articles were found related to tornados and thunderstorms. To fill this gap, research needs to be conducted for the following reasons. (1) Severe weather happens every year, especially in Oklahoma, and severe weather will continue to happen in the future so school decision makers will have to make safety decisions, (2) to identify school decision makers informational needs for these weather related decisions, (3) to identify the key components needed for training the school decision makers to be more effective in their decisions, and (4) to train school decisions makers how to make weather related decisions more effectively, there is a need to identify how administrators currently make weather related decisions specifically for severe weather events.). The study will focus on the following research questions:

1. What are the informational needs most crucial for school decision makers to have in order to make proactive decisions during severe hazardous weather?
2. How can you design instruction and effective learning activities based on documented information needs?
3. Do school decision makers of the weather decision making process understand the complexities, concerns, and information needs of the other stakeholders in the communication chain?

4. Is problem based learning an effective way to train school decision makers to make these hazardous weather related decisions proactively, if so in what ways is problem based learning effective?

One of the greatest challenges for school personnel related to severe weather decision making is a lack of training about how to make decisions when there are many lives at stake. Additionally, each situation they will encounter is different than the past and there is not one correct answer. In order to design the best instruction, a systematic process must be followed to ensure that an intervention meets their needs. Therefore, I used the principles of instructional design as shown in the general ADDIE process but more specifically followed the Morrison, Ross, Kalman, & Kemp (2011) instructional design model to create a training solution to better prepare school personnel for severe weather related decisions. As part of the design process, it was determined that problem based learning (PBL) would be used as the instructional strategy for training school decision makers on severe weather decision making.

Chapter 2: Background of the Methodology

There are many different systematic instructional design models, but most of them are built on a series of general processes referred to as ADDIE. ADDIE stands for: Analysis, Design, Develop, Implementation, and Evaluation. Instead of ADDIE being a standalone model, it really is more of a compilation of parts or components that most instructional design models have embedded within them and whose processes are envisioned differently by different instructional design theorists. Since ADDIE is not a standalone model, not grounded in theory, but instead represents general stages represented in other theoretically based models, it is not robust enough to be the only model when designing instruction. However, because ADDIE is an overall process that is compiled of components of most instructional design models, I will discuss the general components of Instructional Design processes as organized by the stages of ADDIE and then I discuss how I used the specific model designed by Morrison, Ross, Kalman, & Kemp (2011) to design the instructional strategy to train school leaders and emergency managers using a problem based learning (PBL) approach. I choose to use Morrison et al. (2011) as the instructional design model to follow because these authors are recognized as founders of the instructional design field as well as it is one of the most widely used instructional design models.

There are nine distinct elements to the Morrison et al. (2011) instruction design model: instructional problems, learning characteristics, task analysis, instructional objectives, content sequencing, instructional strategies, designing the message, development of instruction, and evaluation instruments. There are also eight ongoing processes described in this instructional design model: project management, planning,

support services, implementation, revision, formative evaluation, summative evaluation, and confirmative evaluation. Figure 7 shows a pictorial representation of the Morrison et al. (2011) instructional design model. Each of these specific elements and ongoing processes from the Morrison et al. (2011) instructional design model will be described as they fit within the relevant general ADDIE processes.

Figure 7. Instructional Design Model

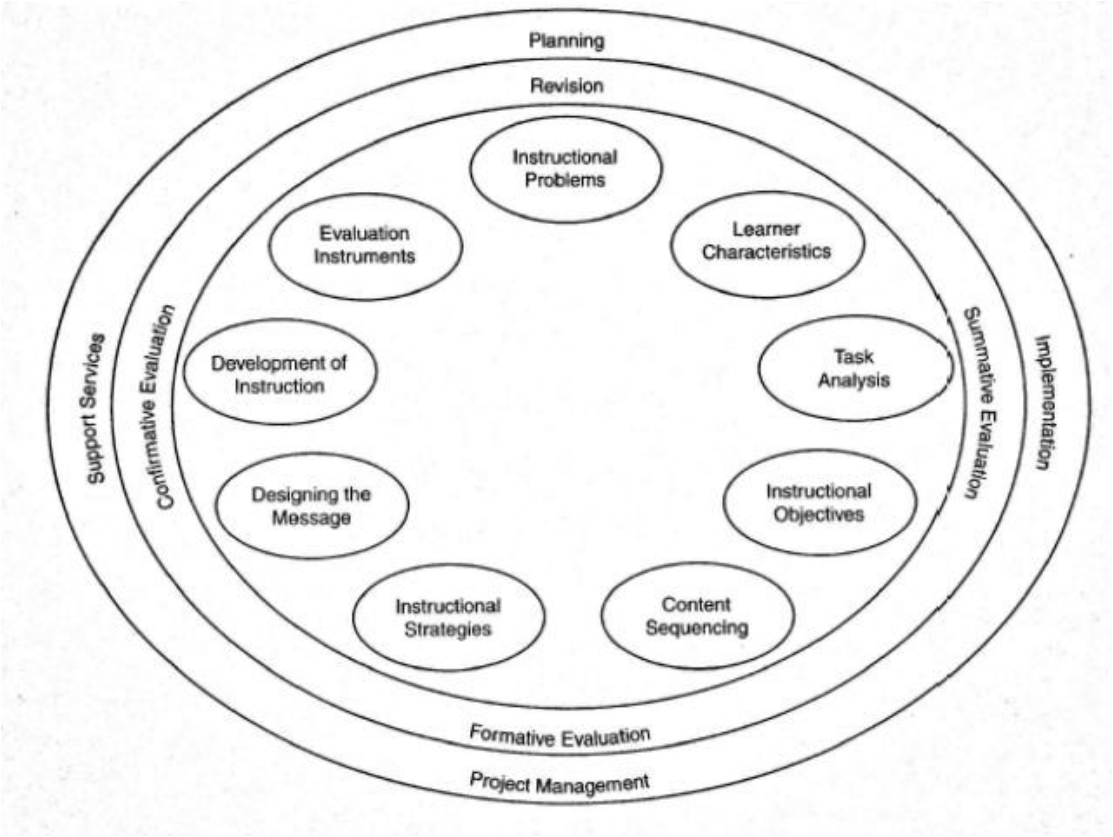

Figure 7.

Morrison, Ross, Kalman, & Kemp (2011) Instructional Design Model. Retrieved from "Designing Effective Instruction" by G. R. Morrison, S. M. Ross, H. K. Kalman, & J. E. Kemp 2011, p. 12. Copyright 2011 by Wiley

General Instructional Design Elements

The first stage in the ADDIE process is Analysis. During this stage, the instructional designer's goal is to figure out what the problem is that the training solution is looking to address. In addition to analyzing the problem, the designer is also analyzing the learner and his/her context. In this stage, the characteristics of the learners, school decision makers and emergency managers, are being analyzed as well as the characteristics of the tasks, proactive decision making, the learners will be asked to complete and the resources needed for the training. In the Morrison et al. (2011) model they expand this stage to look specifically at three elements: instructional problems, learning characteristics, and task analysis.

Morrison et al. (2011) describe the instructional problem as the place to answer 'is instruction needed' and 'why instruction is needed'. To do this, a needs assessment is conducted. A needs assessment is used to identify gaps in learner performance and to determine whether those gaps are worth addressing. Morrison et al. (2011) describe this element to have four functions: identify the needs that are relevant to the job or the task, identify the critical needs (e.g. needs that affect safety), set priority for selecting type of intervention, and it provides baseline data to assess effectiveness of the intervention. As established in chapter one, there is considerable danger, financial impact, and learning disruptions during tornados and severe thunderstorms.

The second element of the Morrison et al. (2011) instructional design model is learning characteristics. This element describes the characteristics of the target audience that are most critical to the achievements of the objectives of the intervention. These types of characteristics can include: general characteristics, specific entry

characteristics, learning styles, academic information, personal and social characteristics, culturally diverse learners, learners with disabilities, and adult learners. In this study, this was achieved by doing a preliminary survey of the target audience, phase one, and following up with a targeted focus group, phase two. Both phases one and two will be discussed in more detail further in this paper.

The third element of this instructional design model is the task analysis element. Morrison et al. (2011) describe this as one of the most, if not the most, important component of the instructional design process. It is during this stage that the designer defines what is included in the instruction so the learner is able to master the objectives of the intervention. This begins with the instructional needs derived from the definition of the problem found from the needs assessment. Conducting a task analysis provides solutions to three problems. The first problem it solves is it defines the content required to solving the problem that has been defined from the needs assessment. Secondly, it forces the subject matter expert to work through each step of the problem so the subtle steps are easily identified and not overlooked. Given the daily outlooks provided by the Storm Prediction Center prior to a hazardous weather day, the problem was defined by how storm information is routinely made available and the communication stream around it. Lastly, by conducting a task analysis it gives the designer an opportunity to view the content from the perspective of the learner. This was achieved in stage two when both school leaders and emergency managers talked about how they act during storm events which helped the designer to understand the task and processes.

The second stage in the ADDIE process is Design. The purpose of the Design phase is to provide guidelines, or blueprints, for developers to follow when producing

the actual instructional materials. It is at this point where the objectives of the instruction are defined from the goals and the lessons and activities are designed to meet those objectives. This is also the point where the designer designs specifics for the evaluation instruments that will be used. There are four elements from the Morrison et al. (2011) instructional design model that fit within the general process of ADDIE: instructional objectives, content sequencing, instructional strategies, and designing the message. The first element, instructional objectives, serves two functions. The first function is it allows the designer to design the instructional activities in line with each objective. The second function it serves is to provide a framework for devising ways to evaluate the participant's success in learning each objective. This allows both formative and summative evaluation in relation to the research questions and learning goals already defined. Since PBL was chosen as the instructional strategy, it was during this phase that both qualitative and quantitative data were collected for the evaluation of the activity to provide both an overview and rich data on the problem solving process.

The second element of the Morrison et al. (2011) design phase is content sequencing. This is the phase of the design where the instructional designer scaffolds how the activities and information are to be presented to the learner. It is important for this step to occur as information should be presented in a way to help participants achieve the learning objectives. Therefore the communication stream was designed by how information is made available during storms, the real world data helped to scaffold the activity design.

The third element within the Morrison et al. (2011) design phase is instructional strategies. This phase is considered the 'creative step' in the instructional design

process. It involves developing creative and innovative ways of presenting content so the participants can integrate the new information with schema they already hold about related topics. The primary goal of this element is to design efficient and effective instruction. The instructional strategy used in this study was PBL. This will be discussed further below in the literature review. The last element from the Morrison et al. (2011) instructional design model that fits within the design portion of ADDIE is the designing the message element. This element is the specific process used to arrange the text and non-text portions of the course. It was this part of the stage that it was decided what parts of the PBL activity needed to be in text (e.g. specific weather information) and what parts needed to be electronic (e.g radar given to participants).

The third stage in the ADDIE process is Development. It is during this phase that the preparation of the materials occurs. The element from Morrison et al. (2011) that fits within the development component is the development of instructional elements. This is the process in which the blueprint that was created is used to produce the materials of the PBL activity. This includes the video recordings, web pages, print materials, or audio tapes. This element focuses on the sequencing that was chosen and the instructional strategies chosen from earlier in the design process to develop the materials needed. Since weather events have a general time sequence, the sequencing was prescribed by real world data in making the problem authentic, an important characteristic of PBL (Jonassen & Hung, 2008).

The fourth stage in the ADDIE process is Implementation. This stage has two parts to it. The first part is a pilot test for the learning activity as it is still being developed. This pilot test allows the designer to verify the accuracy of the needs

analysis and design decisions based on members of the target audience. It also allows the designer to change features of the instruction before the actual implementation. When a pilot test is used, it will be combined with a formative evaluation which will be discussed below. The second part is the actual delivery of the course after design and development are revised from the pilot test. Implementation is one of the ongoing processes described by Morrison et al. (2011). They describe it as an ongoing process because as the design of the instruction is occurring, you are planning the implementation of it. This is saying that throughout the entire instructional design process, one should think about the implementation of instruction instead of only during the time of facilitation. For this study, both a pilot test and the full launch implementation were conducted.

The fifth and final stage in the ADDIE process is the Evaluation stage. Evaluation typically occurs more than just at the end of the course. As stated in the implementation section, typically a designer will implement a pilot test of the course and conduct a formative evaluation. This type of evaluation allows the designer to make changes in the design that are needed before the full implementation of the course. The element from Morrison et al. (2011) that fits within this stage is the evaluation instruments element. This is the element where the evaluation instruments are used to assess the learners' mastery of the objectives. Not only does this one element from Morrison et al. (2011) fit within this stage but three ongoing processes describe by the authors also fit within this evaluation stage: formative evaluation, summative evaluation, and confirmative evaluation. Formative evaluation was briefly mentioned above. This type of evaluation has to function to inform the instructor or planning team

how well the program is serving the objectives. It is for this reason that pilot tests are conducted. For the current study, debrief questions of the pilot test served as a formative evaluation. For the purpose of this study it allowed the researcher to develop debrief questions for the actual PBL activity implementation. Debrief of the pilot test also lead to a pre/post questionnaire that was administered before and after the actual PBL activity implementation. Both of these types of evaluations will be discussed further later in the paper. A second type of evaluation is a summative evaluation. This type of evaluation is directed toward measuring the degree to which the participants attained the major objectives of the course (e.g. final examinations). Lastly the confirmative evaluation is a follow-up evaluation. This follow-up addresses whether the learners are continuing to perform successfully over time, it evaluates that the materials still meet their original objectives, how the clients' needs can be best met over time, an whether improvements are needed in the training materials and how those improvements can be made most effectively. In regards to the current study, the first two types of evaluation, formative and summative, are used. Formative evaluation is used after the pilot test and summative after the full implementation of the PBL activity.

Evaluation is the last stage of the instructional design process of ADDIE. However, Morrison et al. (2011) mention three other ongoing processes: support services, planning, and project management. Support services are all the different professions or subject matter experts, which help throughout the instructional design process. In some smaller projects, the instructional designer may provide all the services needed. In larger projects support series could include web designers, script writers, video producers etc. As the researcher for this study, I serve the roles of the project

manager, planner, and the meteorological subject matter expert throughout the entire instructional design process. The ongoing process of planning described by Morrison et al. (2011) says the amount of planning depends on the scope and complexity of the project. This basically says that the larger the scope and the more complex the project the more planning and continually adjust the planning occurs. The process has three constraints as noted by the authors: time available, degree of quality required, and the available budget. The last ongoing process is the process of project management. This again is dependent on the scope and the complexity of the project. For larger projects the project it typically launched with a kickoff meeting to help with the aim and to make sure everyone gains a common understanding of the goals, scope, and individual responsibilities. The project managers are responsible for managing resources, tracking completion of tasks, and to keep clients informed of the projects progress. Part of future growth plan of this study is to design something that could be repeated with different groups beyond this thesis and that is where long term project management would also be needed.

Problem Based Learning

Part of the design phase of instructional design is to select a framework of instructional strategies that will be employed for the learners. Given the target population and the real world experiences for which they are being prepared, I chose problem based learning (PBL). PBL is a learner-centered approach allowing learners to integrate theory and practice, and apply knowledge and skill in small groups to develop a viable solution to a problem (Jonassen & Hung 2008; Remedios, Clake, & Hawthorne, 2008; Savery, 2006). It gives participants the opportunity to share large workloads and

learn from other perspectives on their own as well as function as a content expert for a group of their peers (Hmelo-Silver & Barrows, 2006; Schuh & Busey, 2001). The overall goal of PBL is to enhance application of knowledge, problem solving, and self-directed learning skills (Jonassen & Hung, 2008) while building critical thinking skills as a team by learning collaboratively, problem-solving collaboratively, and achieving individual curriculum outcomes collaboratively (Kelson & Distelhorst, 2000). There are a few general principles for using PBL. Problems must be open-ended and ill-structured (Jonassen & Hung, 2008; Savery 2006). That is the structure of the problem lacks definition in some respect (Simon, 1973). The problem must also be complex where the challenge is motivating and engaging to participants and their interests while also adapting to their prior knowledge of the subject matter (Jonassen & Hung, 2008). It also needs to be contextualized to the participants' current or future workplaces (Jonassen & Hung, 2008).

Using PBL as the instructional strategy was the best choice for training school decision makers to make proactive hazardous weather decisions because the goal is to enhance their applications of what they already know about storms into actions that allow them to keep schools safe. PBL also allowed participants to use problem solving techniques to find a solution collaboratively by thinking as a team to agree upon decisions during a past severe weather event. PBL motivated the participants to use self-directed learning skills because they know from their past experiences severe weather decisions need to be made and it is their responsibility to make them. Severe weather events are ill-structured because of the ever changing environment and the fact that no storm is exactly the same as another.

PBL was first developed in the medical field, and it is still used widely (Lee & Kwan, 1997). PBL paired with simulations allows medical students to learn how to address complex problems without putting real patients at risk (Halm, Lee, & Franke, 2010). It also allows students to have a level of emotional understanding about what it would be like to have a real patient (Halm, Lee, & Franke, 2010). PBL has been used in other contexts and professions with varying problems from one area to another depending on subject matter (Jonassen & Hung, 2008). For example, PBL is being used in the medical profession, as mentioned, to increase clinical reasoning skills (Crawford, 2011; O'Connor & Carr, 2011; Santiprasitkul, Sithivong, & Polnueangma, 2013; Wilson, 2012), engineering to solve design problems and critical thinking skills (Glatz et al., 2006; Santos-Martin, Alonso-Martinez, Carrasco, & Arnaltes, 2012), social work (Lam, Wong, Hui, Lee & Chan, 2006; Williamson & Chang, 2009; Wong & Lam, 2007), and in teaching writing (Smart, Hicks, & Melton, 2012).

There has been a current study that assesses the usefulness of PBL in the meteorology field. It looks at the possible feasibility while teaching meteorology students at the undergraduate and masters level within UK Universities (Charlton-Perez, 2013). This author used two different PBL activities with two separate groups of individuals. The first activity was a designed experiment to launch an ozonesonde with a weather balloon. This instrument measures ozone concentrations throughout the atmosphere. The second activity students were required to design a new climate monitoring station based on their experiences of the field course location, meteorology, and their own research from existing literature. These studies were implemented twice, first in the 2008-2009 academic year and second in the autumn of 2010, after some

modification. Charlton-Perez (2013) used student feedback in the form of a questionnaire, peer observation, results from student outputs, and personal reflection as evaluation techniques. The author found the use of PBL within the meteorology context to be successful. It provided useful new content for an already existing course with an innovative teaching type that was unfamiliar to students. By implementing PBL, it emphasized that the key gain was in the real-world simulation aspect and its effect on student motivation. Students' motivation was increased by using PBL with one participant stating that it encouraged their learning. The author does state that PBL along with some peer review within the meteorology field may benefit and better prepare students for workplace environments by providing a simulation of the practice of real-world scientific research. However, it is also stated that PBL amongst meteorology students would be most beneficial with students who are in the final year of their undergraduate schooling or masters level. This is because of the background within the field that is needed in order to understand the physics and chemistry behind the problems given.

With exception of the Charlton-Perez (2013) study, PBL is not widely discussed in regards of training for meteorological problems. Weather is a dynamic process. That is it is ever changing and there is not one storm that is exactly like a previous one. This makes it well suited for PBL investigations because weather decisions are naturally ill-structured (Jonassen & Hung, 2008; Savery 2006). Because of their ever changing structures one cannot define how storms 'work' or what differs one storm from another. Another characteristic of PBL is the problem must be complex, motivating and engaging while allowing participants to adapt their past experiences to the current

problem (Jonassen & Hung, 2008). Personal experience of a disaster and the effects of the hazard affects how a person will interpret their experience and what they have learned from the experience (Lindell & Perry, 2000; Terpstra, 2011). In addition, PBL must allow participants to apply knowledge and skill while working in small groups to develop a viable solution (Jonassen & Hung, 2008; Remedios et al., 2008; Savery, 2006). Since every storm is different in some way, it is not possible to know exactly what is going to happen, this makes it complex to try and make decisions in regards to the storm. In addition, since school decision makers are in charge of many lives they are motivated to try and make the best decision possible with the situation at hand. Additionally, school decision makers are typically working collaboratively with more than one person within their district to make severe weather decisions. Living in a region where severe weather happens every year, participants all have different past experiences about a tornado or storm decision they have had to make in the past. They are able to adapt that experience to the current problem to compare the similarities and differences while working within small groups.

Although PBL has not been widely used within the meteorological subject matter, it has been used within other cross-discipline emergency preparedness training. Streichert et al. (2005) use PBL in conjunction with fire, EMS, law enforcement, emergency managers, public health, and hospitals. The authors noted that members of these professionals are typically 'imperfectly' aware of working styles, assets, strengths, and limitations of partner disciplines. These professionals collaborated with facilitators and education consultants to write three cases: a radiological attack of water supply, ricin poisoning incident that involved two state jurisdictions, and a broadcast anthrax

release in an urban setting. Each of these cases are dangerous in nature and depend on lifesaving response relies on close collaboration across multiple agencies and disciplines. Authors used informal course evaluations, pre/post surveys, and debrief discussions to assess the participants perceptions of the value of the training. It was noted that PBL was a new way of learning for almost all participants. Even with this being the case, the majority of participants reported that PBL contributed to the training because it was more realistic and it allowed interaction between a diverse group of professionals. One of their participants mentioned that because of the PBL activity, they realized how important communication is when dealing with dangerous events. Overall the authors show that PBL brought enthusiasm, multi-gender collaboration, and accelerated learning to their participants. This study shows that PBL is in fact appropriate for use amongst school decision makers and emergency managers amongst the subject of severe weather decision making because of the dangerous aspect of the topic and the need for collaboration amongst stakeholders.

The goals of PBL are to enhance application of knowledge, problem solving, self-directed learning skills, build critical thinking skills as a team by learning collaboratively, and achieve individual curriculum outcomes collaboratively (Jonassen & Hung, 2008; Kelson & Distelhorst, 2000). Using PBL amongst school decision makers allows them to bring their past experiences together and learn collaboratively (Bridges & Hallinger, 1997). It also allows them to reach individual decisions while working towards common goal collaboratively. By solving complex problems they will help each other with their problem solving skills (Bridges & Hallinger, 1997) as well as

learn to acquire more information (enhancing their self-directed learning skills) when a hazardous weather decision needs to be made in the future.

With an average of about 60 tornadoes a year and many more severe thunderstorms each year in the state of Oklahoma, severe weather decisions are prevalent every year for school decision makers. Additionally, as mentioned earlier, there are built in communication and information delays when it comes to the decision making process. Training is needed to help decrease this delay and to increase the confidence of school decision makers when a decision must be made during a storm while lives are at risk.

PBL allows decision makers to grapple with the difficult challenges in a safe learning environment without lives at risk. Real past severe weather events are available and contain the rich cases that help create the problems that will be realistic, relevant and mirror real life (Jonassen & Hung, 2008). Since making decisions regarding weather happens each year for a variety of reasons in schools, participants will be motivated and more willing to engage in learning because they will see the relevance and context of how it applies for future weather events. Additionally, using PBL will allow superintendents to look at the problem from different perspectives (e.g. as an emergency manager or teacher) while working collaboratively and introducing their own content expertise. By working collaboratively, participants will be able to bring their past experiences of severe weather and prior knowledge of types of decisions that need to be made to the small groups to discuss and try to apply to the current problem to come up with a solution.

Chapter 3: Analysis (Phase One)

There were three phases to this study each a part of the instructional design process. Phase one consisted of a survey, phase two was a focus group, and phase three was the implementation of a problem based learning activity. Phases one and two were a part of the Analysis part of the ADDIE instructional design process and phase three was the Implementation and Evaluation phase of the ADDIE instructional design process.

As mentioned in chapter two, Analysis is the first stage in an instructional design process and according Morrison et al. (2011) the first element in the analysis phase is instructional problems. It is during this stage that the designer identifies and defines the problem as well as learn the characteristics and information needs of the target audience. The purpose of phase one was to investigate the problem of how weather decisions are made in schools as well as begin to answer the first research question of what the informational needs are of school decision makers in order for them to make proactive weather decisions during severe hazardous weather. This was done by a survey administered throughout the state of Oklahoma.

Participants

Participants in phase one consisted of emergency managers (n=43), school district personnel (n=29), and school building personnel (n=241) across the state of Oklahoma. These participants were chosen because they represent different levels in the communication chain. The participants were recruited using an IRB Approved recruitment e-mail which was sent using the Oklahoma Climatological Survey's emergency manager and school outreach email lists (See Appendix A). Once the initial

e-mail was sent, snowball sampling was used by asking participants to invite others in their professions to participate in the survey (Creswell, 2012a). I chose participants across the state because I wanted to have a representation of urban and rural areas. Given their geographic diversity, these participants were surveyed using an online survey in order to gain this representation. Figure 8 shows the geographic distribution of professionals who participated in the survey. Participants were asked whether they have had formal weather related training. Figure 9 displays the weather training background results split into three general categories: emergency management, school district, school building personnel. The three categories were split according to profession where emergency management consisted of personnel working specifically in the emergency management office, school district consisted of personnel working specifically in the school district office, and school building personnel were personnel working at the individual school sites (e.g. principal, teacher, librarian, etc.). Additionally participants were asked how long they have been in their current positions, Table 1 displays these results.

Figure 8. Survey Participant's Professions (n=213)

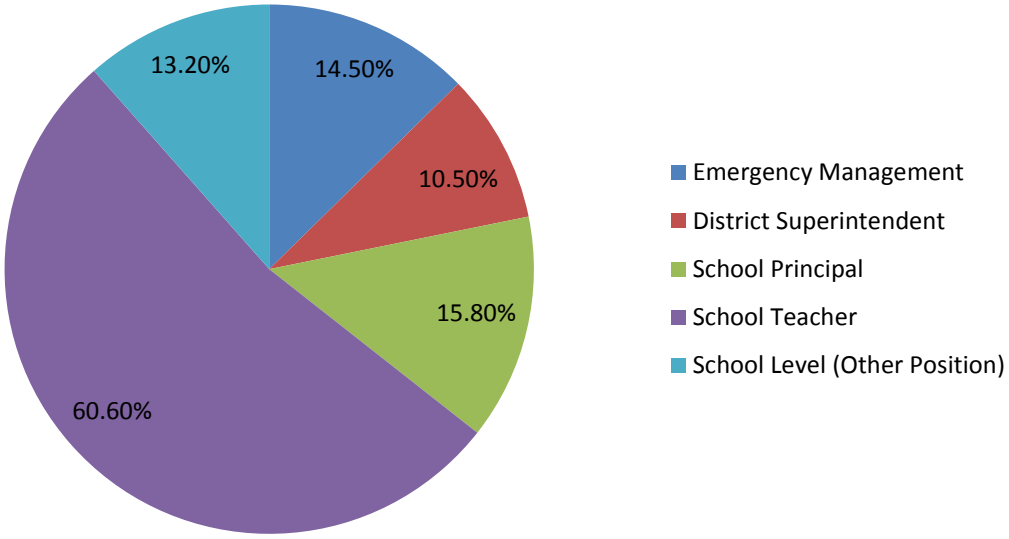

Figure 8: Percentages of participant's professions who participated in the statewide online survey.

Figure 9. Formal Weather Related Training (n=313)

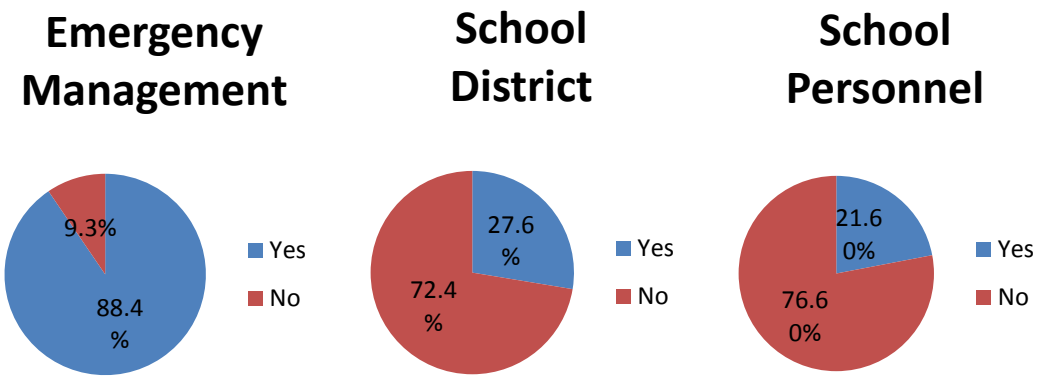

Figure 9: Percentages of participants who have and have not had formal weather related training.

Table 1

Length in Current Position

About how long have you been in your current position…?	Emergency Management (n=43)		School District (n=29)		School Building Personnel (n=241)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0-5 Years	16	37.2%	11	37.9%	83	35.8%
6-10 Years	11	25.6%	11	37.9%	61	26.3%
11-15 Years	8	18.6%	1	3.4%	25	10.8%
>15 Years	8	18.6%	6	20.7%	61	26.3%

Data Collection

An online survey was administered to collect quantitative data and open ended responses. The survey instrument is split into three professional sections: school building personnel, district personnel, and emergency management. The reason the survey is split into these three sections is for the ease of phrasing questions to relieve the confusion for what and who the question is asking. Each section has questions dealing with four different constructs: preparedness, weather information, communication, and past experiences (see Appendix B for questions split by construct specific items).

These constructs were found by looking at how to define how a person perceives their risks and makes decisions, in relation to severe weather. Risk perception has many different, more specific definitions depending on the context it is used in. However, as a general sense, risk perception is the judgment that people make about the severity and characteristics of risk (Slovic, 1982). Risk perception is not one specific construct but instead other ideas or constructs contribute to how a person perceives their risk,

specifically the constructs of preparedness, weather information, communication, and past experiences.

Looking at the research on risk perception is how these different constructs used in the survey were identified. To find studies, I used a narrowed search at first to try and find studies in which risk perception is the key component to decision making during hazardous weather. It was then also thought it would be best to look at general risk perception as it pertains to the most general, every day, situations. The search of studies began with and online search of meteorological journals from the American Meteorological Society (AMS) website. Additionally a search was done with the online database: "EBSCOhost" using 'risk perception', 'decision making', and 'hazardous weather' as key words and phrases. Once an article base was found, using reference sections was the next means of study gathering. After the four main sub-constructs were identified, another search of the database "EBSCOhost" was used pairing 'risk perception' with the following keywords: 'preparedness', 'trust', and 'past experiences'. Both qualitative and quantitative research studies were used in the gathering of studies. Additionally, there was not a limited time period in which these studies needed to be conducted in, however all studies were found online.

Preparedness. Preparedness is defined in this context as self-protective activities for a hazardous weather event that reduces the loss of life, injury, and property, along with lessening the impact of the event (Kano & Bourque, 2012; Gillespie, Coligon, Banerjee, Murty, & Rogge, 1993; Mishra & Suar 2007). There were 12 questions assessing preparedness for school building personnel, 14 for district personnel, and 13 for emergency management. Likert type items were used to measure

how schools perceived themselves as being prepared (e.g. “Our school has a hazardous weather safety plan or policy”) on a scale from (1) “strongly disagree” to (5) “strongly agree”.

Weather information. The purpose of using weather information as one of the constructs is to find out where school and school districts receive their weather information, what information they use to make decisions, and to find out how comfortable they feel using weather information to make decisions. A total of six questions were asked in regard to weather information to school building personnel and district personnel. It did not make sense to ask EMs information on this because they are, or should be, one of the sources of weather information to schools. Four-point Likert type items were used to gain insight on how much certain information was relied on (e.g. “How much does your school rely on the outdoor warning systems (sirens) to make critical decisions during a severe hazardous weather event day when school is in session?”) on a scale of “do not rely on”, “somewhat rely on”, “significantly rely on”, or “not sure”. Additionally, five-point Likert type items were used to ask what way information is received during hazardous weather (e.g. “Our school has multiple ways of receiving critical weather information”) and how participants perceive their ability to make decisions with such weather information (e.g. “I feel confident about understanding a weather 'warning' map and knowing what it means”) using a scale of (1) “strongly disagree” to (5) “strongly agree”.

Communication. The communication construct is used to find out what communication (if any) occurs between district offices and emergency managers, schools and emergency managers, and district offices and schools during severe

weather. Five items were asked to school building personnel and district personnel, and two items to the emergency managers. Likert type items were used to find what communication occurs between stakeholders (e.g. "The emergency manager communicates with the superintendent for our district during hazardous weather") using a scale of (1) "strongly disagree" to (5) "strongly agree". Multiple choice questions were also used to gather information on how parents and bus drivers are communicated to during severe weather.

Past experience. The purpose of using past experience as a construct is because a person's perception of risk tends to vary depending on the scenario and feedback from previous experiences (Leclerc, Schmitt, & Dube, 1995; Keller, 1985; Weber & Bottom, 1989; Weber & Milliman, 1997). What has happened in the past effects what a person, or school district, judges the risks for a current situation that is similar to a past event. Because every person may have a different past experience, I asked an open-ended question to see how their past experience affected what they currently do during severe weather events. This question was optional. Each of the three types of stakeholders were asked this question.

Data Analysis

The Statistical Package for Social Sciences (SPSS) was used to analyze the survey data collected. Descriptive statistical analysis was conducted to analyze the frequencies, means and standard deviation for the collected data.

Results

A survey was administered to emergency managers, school district personnel, and school building personnel across the state of Oklahoma. Zip code locations were asked to ensure a statewide sample was taken. These results can be seen in Figure 10. This results section reports on the results from the survey and is organized by construct: preparedness, communication, weather information, and past experiences.

Figure 10. Map of Survey Participants

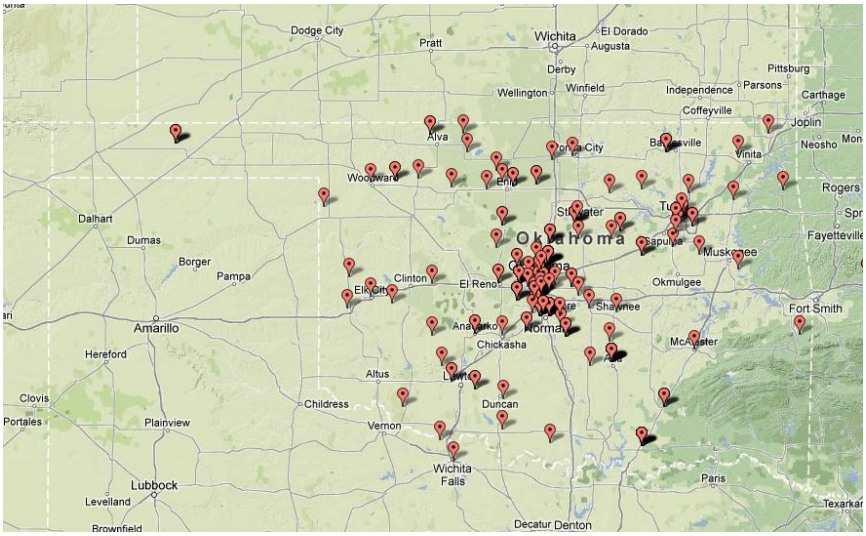

Figure 10. Map of survey participants from phase one of the current study.

Preparedness. Preparedness was defined as any self-protective activities that are planned before a severe weather event to reduce the impact of the event. It was found that the majority of the schools and school districts have a hazardous weather safety plan as well as they know who is responsible for activating that plan. This is consistent with state law that says schools must have emergency plans that include natural and man-made disasters which must be submitted to the state (Rep. No. 258,

2013). One of the preparedness questions asked if schools had a NOAA Weather Radio, 47% of schools and 38% of districts replied with disagree or neither agree nor disagree, indicating they didn't know or did not have one. A couple of responses that are encouraging to see is schools and districts feel their shelter would keep them safe during a tornado, and over 70% of schools and over 85% of districts feel their schools are able to handle any hazardous weather event that happens on a school day. The majority of schools and school districts do say they conduct tornado drills at different times of the day, 86.2% and 93.1% respectively. However, these numbers decreased, from 86.5% to 61.7% for schools and 93.1% to 44.8% for districts, when asked if drills are conducted at the beginning or end of the school day. Table 2, 3, and 4 show frequencies and descriptive statistics for the preparedness construct. Table 3 and 4 are separated because only the participants that responded 'yes' to the question in table 3 responded to table 4 questions. Tables 5, 6, and 7 show the frequencies and descriptive statistics for the emergency manager preparedness construct with table 6 and 7 separated because participants only answer questions from table 7 if they answered 'yes' to the question in table 6.

Table 2

Frequencies and Descriptive Statistics for Preparedness Construct

	School (n=232)					School District (n=29)				
Question	SD/D	N	A/SA	$\bar{X}$	SD	SD/D	N	A/SA	$\bar{X}$	SD
Our designated shelter location in our school would keep us safe during a tornado.	25.9%	9.5%	63.8%	3.47	1.26	3.4%	24.1%	72.4%	3.97	0.82
I am confident in the duties I am responsible for when severe weather is present.	7.8%	4.3%	87.1%	4.17	0.93	0%	3.4%	96.5%	4.55	0.57
Schools rehearse tornado drills at different times of the day.	9.9%	3.9%	86.2%	4.19	1.06	0%	6.9%	93.1%	4.48	0.63
The Schools in my district rehearse tornado drills at the beginning and/or end of the school day.	25.5%	12.1%	61.7%	3.63	1.33	17.2%	37.9%	44.8%	3.45	1.09
I feel schools are able to handle any hazardous weather situation that happens on a school day.	11.7%	16.4%	72%	3.78	1.00	3.4%	10.3%	86.2%	4.21	0.77
Schools have a NOAA Weather Radio	8.6%	38.4%	43.9%	3.62	1.05	13.7%	24.1%	58.6%	3.79	1.12
If a severe weather decision was left to me, I would feel confident in my weather knowledge to make a decision for my school.	13.3%	14.2%	65.1%	3.87	1.11	6.9%	6.9%	82.8%	4.14	0.85

Table 3

Frequencies and Descriptive Statistics for Preparedness Construct Cont.

Question	Schools (n=232)				School District (n=29)			
	Yes	No/I don't know	Mean	SD	Yes	No/ I don't know	Mean	SD
Each School has a hazardous weather safety plan.	90.3%	8.6%	1.08	0.284	89.7%	10.3%	1.10	0.310

Table 4

Frequencies and Descriptive Statistics for Preparedness Construct Cont.

Question	School (n=232)					School District (n=29)				
	SD/D	N	A/SA	Mean	SD	SD/D	N	A/SA	Mean	SD
I know exactly for what hazardous weather events my school enacts the weather safety plan.	6.9%	9.1%	74.6%	3.99	0.89	3.4%	6.9%	75.9%	4.08	0.70
I know who the individual(s) is/are responsible for activating weather emergency plans.	7.8%	6.0%	76.8%	4.08	0.95	0%	3.4%	82.8%	4.36	0.57
When the weather emergency plan is activated, I feel confident with what I am supposed to do/how I am supposed to react.	6.9%	3.0%	80.6%	4.19	0.91	0%	3.4%	82.8%	4.36	0.57
The weather emergency plan or policy accounts for a variety of scenarios.	19.4%	19.4%	51.3%	3.49	1.13	0%	10.3%	75.8%	4.16	0.62

Table 5

Frequencies and Descriptive Statistics for EM Preparedness Construct

Question (n=43)	SD/D	N	A/SA	Mean	SD
The designated shelters at the schools in the district I am responsible for would keep the students and staff safe during a tornado.	16.3%	30.2%	51.2%	3.38	1.04
I am confident in the duties I am responsible for when severe weather is present.	2.3%	2.3%	95.4%	4.28	0.63
I am confident the superintendent knows the duties they are responsible for when severe weather is present.	7.0%	14.0%	79.1%	3.86	0.74
Schools in the district I am responsible for have rehearsed tornado drills at different times of the day.	11.7%	16.3%	72.1%	3.77	1.02
Schools in the district I am responsible for have rehearsed tornado drills at the beginning and/or end of the school day.	13.9%	48.8%	34.9%	3.31	0.92
I feel the schools in the district I am responsible for are well prepared and able to handle any hazardous weather situation that happens on a school day.	9.3%	34.9%	55.8%	3.58	0.82
The schools in the district that I am responsible for all have a NOAA Weather Radio.	2.3%	14.0%	65.1%	4.20	0.83
If a severe weather decision was left to the superintendent, I feel confident in their weather knowledge to make safety decisions for their schools.	9.3%	20.9%	51.2%	3.63	0.84

Table 6

Frequencies and Descriptive Statistics for EM Preparedness Construct Cont.

Question (n=43)	Yes	No/I don't know	Mean	SD
Each School has a hazardous weather safety plan.	90.3%	8.6%	1.08	0.284

Table 7

Frequencies and Descriptive Statistics for EM Preparedness Construct Cont.

Question (n=35)	SD/D	N	A/SA	Mean	SD
I know exactly for what hazardous weather events the schools enact their weather safety plan or policy.	20.9%	9.3%	51.2%	3.66	1.62
I know who the individual(s) is/are responsible for activating weather emergency plan or policy.	16.3%	0.0%	65.1%	3.94	1.08
The school's weather emergency plan or policy accounts for a variety of scenarios, such as hazardous weather occurring before, during, and after school as well as during arrival and departure times.	14.0%	9.3%	58.1%	3.80	1.02

Weather information. Weather information was defined as weather information that is relied on to make decisions in schools and school districts and how comfortable they feel using certain weather information to make decisions. When asked the question of how much sources are relied on to make critical decisions, each source was posed as a different question. It was found that 50% of schools either somewhat or significantly rely on the NOAA Weather Radio and approximately 80% of schools districts rely on it to make critical decisions. Additionally, 72% of schools and 86% of districts also rely on the outdoor warning systems (sirens) when making critical decisions during hazardous weather. The NOAA Weather Radio will send messages when both a watch and warning are issued by the National Weather Service and the sirens are only sounded when the emergency manager chooses (most of the time when a tornado warning is issued). If schools and superintendents are waiting until warnings are issued to make critical decisions, there may not be enough time to get everyone to safety. The current average lead time is 11 minutes (Simmons & Sutter, 2008). If a tornado warning occurs at the end of a school day when buses are taking students home,

and sports practices are outside on their fields, it is going to take longer to communicate and move people to safety than if everyone is sitting in classrooms. However, it was encouraging to see over 85% of schools and districts feel comfortable understanding a weather watch and weather warning map. Additionally, over 78% of schools and 93% of districts feel comfortable understanding radar to make decisions when it comes to hazardous weather. Tables 8 and 9 show frequencies and descriptive statistics from every question in this weather information construct.

Table 8

Frequency and Descriptive Statistics for Weather Information Construct

	School (n=232)					School District (n=29)				
Question	SD/D	N	A/SA	Mean	SD	SD/D	N	A/SA	Mean	SD
Schools have multiple ways of receiving critical weather information.	1.3%	12.5%	78.9%	4.09	0.70	3.4%	0%	96.4%	4.32	0.67
I feel confident about understand a weather watch map and knowing what it means.	2.6%	3.0%	87.9%	4.45	0.75	0%	6.9%	89.6%	4.32	0.61
I feel confident about understanding a weather warning map and knowing what it means.	2.6%	2.6%	88.4%	4.46	0.75	0%	6.9%	89.6%	4.32	0.61
I feel confident about understanding and using radar to aid in a weather safety decisions.	5.6%	8.6%	78.8%	4.22	0.91	3.4%	0%	93.1%	4.29	0.70

Table 9

Frequency and Descriptive Statistics for Weather Information Construct Cont.

How much do you rely on the sources of information when making a hazardous weather decision…?	School (n=232)				School District (n=29)			
	Not Sure	Do Not Rely on	Somewhat Rely On	Significantly Rely On	Not Sure	Do Not Rely on	Somewhat Rely On	Significantly Rely On
Local Weather Expert (parent who is a meteorologist)	32.3%	23.7%	15.1%	20.7%	10.3%	37.9%	31.0%	17.2%
National Weather Service Phone	34.5%	17.7%	12.5%	27.2%	10.3%	37.9%	24.1%	24.1%
National Weather Service Website	28.4%	6.0%	17.2%	40.9%	6.9%	6.9%	24.1%	58.6%
NOAA Weather Radio	31.5%	6.5%	16.4%	38.8%	6.9%	10.3%	27.6%	51.7%
Outdoor Warning System (Sirens)	16.4%	4.7%	14.7%	57.3%	3.4%	6.9%	20.7%	65.5%
Radio	22.4%	8.2%	22.8%	38.8%	13.8%	20.7%	58.6%	93.1%
Television	22.4%	6.5%	17.7%	47.0%	3.4%	0%	17.2%	75.9%
Weather App on Phone or Tablet	30.6%	11.2%	24.2%	31.6%	10.3%	34.5%	48.3%	93.1%
Weather Company Website (Paid Subscription	46.6%	35.3%	3.0%	5.6%	3.4%	75.9%	10.3%	3.4%

Communication. Communication was used to find out whether communication occurs between district offices, emergency managers, and schools during severe weather. It was found that 48% of schools and 27% of districts either disagreed or neither agreed nor disagreed, indicating they didn't know, if the emergency manager communicates with schools. Additionally, about 44% of schools and 24% of districts stated they disagreed or didn't know whether emergency management communicates with the district. Another finding was that about 32% of schools disagreed, or didn't know, if the district communicates with schools during hazardous weather events. To put this into perspective, there are 554 public school districts in the state of Oklahoma and over 2,200 public schools (Oklahoma State Department of Education, 2013). This means that 682 schools are not being, or don't know, communicated with from their district during a hazardous weather event. Table 10 and 11 show the frequencies and descriptive statistics from the communication construct of the survey.

Table 10

Frequency and Descriptive Statistics for Communication Construct

	School (n=232)					School District (n=29)				
Question	SD/D	N	A/SA	Mean	SD	SD/D	N	A/SA	Mean	SD
The emergency management communicates with the school in our district when there is hazardous weather.	8.7%	39.2%	44%	3.57	0.98	6.9%	20.7%	69%	4.0	0.94
The emergency manager communicates with the district office when there is hazardous weather.	4.3%	39.2%	48.7%	3.67	0.89	6.9%	17.2%	72.4%	4.07	0.94
The superintendent communicates with schools during hazardous weather.	5.6%	25.9%	59.9%	3.84	0.92	3.4%	3.4%	86.2%	4.33	0.73

Table 11

Frequencies and Descriptive Statistics for EM Communication Construct

Question (n=35)	SD/D	N	A/SA	Mean	SD
I interact with the schools in the district(s) I am responsible for during hazardous weather.	4.7%	14.0%	62.8%	4.0	0.84
I interact with the superintendent for the district(s) I am responsible for during hazardous weather.	9.3%	20.9%	51.2%	3.77	1.06

Past experiences. Past experiences were defined as an experience that has affected what currently occurs at a person's location during severe weather. Participants were given the option to answer the following "Recall the last time hazardous weather has affected your school. Please provide your thoughts about the experience on,

1. How you felt your school was prepared,
2. What types of information received (or wish you received),
3. Who that information was from,
4. What your school has changed (if anything) because of that experience.

A total of 173 participants answered this question across all three groups combined. Many of the schools responded to specific events and described that their information came from the superintendent or principal. One school teacher stated "We received info through the superintendent and principals. Teachers followed procedures just as when we have the drills." Another said "The weather radio went off just before the emergency manager called the superintendent, who called the elementary, as the town sirens were going off." This last example is an example how communication delays can happen. It takes time to make each phone call and communicate the correct message, therefore making it extremely important for schools to be proactive. Overall the biggest change that was cited was changes to preparedness plans. For example "…We hadn't had an issue after school and didn't have a policy in place. We have learned from that now and are way better prepared." Another example "… As a result, we have developed a more comprehensive weather plan, but it still has not been fully communicated to all staff and students." These are just a few examples but the overall conclusion is that changes to preparedness plans tend to happen after an event occurs at a school.

In summary, it seems as if schools and districts feel they are prepared for hazardous weather. However, when combining preparedness with weather information there seems to be disconnect. The majority of schools and districts stated they use the NOAA Weather Radio when making critical decisions during a hazardous weather

event day, however, close to 50% of schools and about 40% of districts replied that they disagreed or did not know if their schools have a NOAA Weather Radio. One must take into consideration that the survey is self-reported data. There are some researchers skeptical of self-reported data because self-reported data can have high variance (Spector, 1994). It is important for schools and districts to be making proactive decisions when it comes to severe weather because of the many lives they are responsible for on any given day.

How results of Phase One Provided Guidance to the Design of Phases 2 and 3

Analysis of phase one allowed me to explore how hazardous weather decisions are made in schools. It also demonstrated information needs and what information participants used to make decisions. This was done by asking a series of questions within four different constructs: preparedness, weather information, communication, and past experiences. Each construct contributed to the design of both of phases two and three of this study.

Preparedness. The results of phase one revealed that schools feel they are prepared for a weather event. In addition it showed that the majority of school building personnel (65%) and district personnel (80%) felt comfortable making a severe weather decision if it were left to them. This provided guidance as to whom to include within the problem based learning (PBL) activity, phase three. Since the school building participants and district personnel of phase one felt competent to make severe weather decision if it was left to them, it indicated that participants from both locations of the school chain would be ready and have enough prior knowledge to complete a PBL activity based on a severe weather decisions.

Weather information. From the results of phase one, it was shown there are weather information needs that school decision makers lack in order to make hazardous weather related decisions. However, it is unknown the exact characteristics of those needs. It seems there is an overarching need for schools to be able to make proactive decisions; however, they are not being trained on how to make those decisions. Results from this phase provided inspiration to conduct a focus group, phase two, which explored the characteristics of the possible participants and tasks of a possible training workshop. From the survey, schools and districts said they use the NOAA Weather Radio and outdoor sirens to make critical decisions during a severe weather event. However, even though they say they use the NOAA Weather Radios, 47% of schools and 38% of districts state they do not have, or they do not know if they have, a NOAA Weather Radio. This says there is a disconnect of what information they are truly using the make weather decisions and this adds to the complexity of the decision making process. Both sirens and the NOAA Weather radio are important informational sources for schools so both were incorporated into the design of phase three, the PBL activity.

Communication. This survey showed that there is a need for schools and districts to have a better understanding of the warning process and a need for techniques for proactive decision making. Additionally, communication is important when hazardous weather is present. It has been shown in the literature that there is already a built in delay within the communication (Schumacher et al., 2010), however this is only true if communication is occurring. The survey showed that 31.5% of school building personnel believe there is a lack of communication or no communication from the district level. This says there is a need for each stakeholder (schools and districts) to

have a better understanding of each other's roles during hazardous weather. That is, it is important for districts to gain insight on what scenarios happen at schools during hazardous weather and also for schools too gain insight on what scenarios happen at districts during hazardous weather. Additionally, phase one showed that 24% of districts say that emergency managers do not, or they are unsure, communicate with the district during severe hazardous weather. This gave inspiration to invite both of these stakeholders to the focus group to get them in the same room to foster communication between the two. Lastly, it was shown that there is a need for school districts and building personnel too gain an understanding of other stakeholder's roles during severe hazardous weather. Because of this, a switched role activity was incorporated into the design of the PBL activity in phase three.

Past experiences. From the results of phase one, participants mentioned that their past experiences did affect how they make decisions in the future. In addition, they also mentioned that they made changes to their preparedness plans after they experienced a weather event first hand. These results yielded additional inspiration to conduct a focus group (phase two) to gather more information about how past experiences affect weather related decisions in schools. This focus group also helped to reduce the negative effects of self-report data and to give additional data to verify responses (Spector, 1994). To do this, the scenarios that were used in phase two to guide discussion, were modeled after a recent event that happened in Oklahoma. Knowing schools and districts use past experiences to make current safety decisions, it shows that using small groups of intermixed districts within the PBL activity helps

participants learn from one another. The decision to mix the participants among districts during the PBL activity will be discussed more later in the paper.

Given the information collected during phase one, the instructional problem was defined as school decision makers have a lack of understanding of other stakeholders concerns, complexities, and informational needs as well as there is a lack of communication between school decision makers. Phase one also shows there is a lack of proactive decision making when it comes to severe weather (e.g. using a tornado siren to make critical decisions), and a lack of understanding about available weather information and the communication stream around it. In addition, although learners seem willing to participate, and there is interest from schools in the OK-First emergency management training, this training is not designed for school decision makers and so there is a need to investigate how to best train these school decision makers.

Chapter 4: Analysis Part 2 (Phase Two)

The purpose of phase one was to begin identifying the problem, and defining learning characteristics of the audience as well as begin answer the first research question of what the informational needs are of school decision makers. Phase two of this study is an extension of phase one and the analysis stage of the ADDIE instructional design process. It was mentioned in chapter two that there are three elements from Morrison, Ross, Kalman, & Kemp (2011) that fit within the analysis portion of the ADDIE instructional design process. Instructional problems, Morrison et al's., (2011) first element, and some learner characteristics were conducted in phase one. Phase two consisted of a focus group which addresses the learning characteristics and the task analysis elements described in the model. In addition to addressing the learner characteristics, it allowed the researcher to gather more in-depth information about the problem that was defined from phase one and to add the reliability of qualitative results and reducing issues related to self-reported data by collecting similar data from multiple sources in multiple formats both qualitative and quantitative (Creswell, 2012b; Spector, 1994). Phase two also addressed the first research question of what the informational needs are of school decision makers in order for them to make protective decisions during severe weather.

Participants

Participants of phase two consisted of a warning coordination meteorologist from the National Weather Service (Jason), three emergency managers (Kurt, Jeremy, and Bob), and school representatives from four school districts (Mintrow Public School District, Norfolk Public School District, Mintrow Norfolk Technology Center, and

Lightstow Public School District). I used pseudonyms for the names as affiliations to keep participants and affiliations anonymous. Table 12 displays the names, profession, and affiliation of the participants.

Table 12
Names, Titles, and Affiliation of Focus Group Participants

Name	Professional Title	Affiliation
Jason	Warning Coordination Meteorologist	National Weather Service
Kurt	Emergency Manager	Curtis County
Jeremy	Emergency Manager	City of Mintrow
Bob	Emergency Manager	City of Norfolk
Luke	Superintendent	Mintrow Public Schools
Ralph	Superintendent	Norfolk Public Schools
Howard	Facilities Director	Mintrow Norfolk Technology Center
Nikki	Director Safety Officer	Mintrow Norfolk Technology Center
Dennis	School Principal	Lightstow Public Schools

These participants were chosen because of their locations or jurisdictions near the National Weather Center as well as each having a significant hazardous weather event in the past five years. In addition to each district being located close to the National Weather Center, each district represented a different size of school district, described below. Participants were recruited by an IRB approved e-mail (Appendix A) which was sent to the superintendent of the district. From there, the superintendent decided if they wanted to participate in the focus group and if they were able to attend the date of the focus group. If they wanted to participate but were not able to make the day scheduled, they were allowed to choose a representative from their district.

It was important to have the warning coordination meteorologist involved in the focus group because one of his roles is to manage hazardous weather preparedness,

education and outreach programs. Additionally he is in the local weather forecast office during every severe weather event and he knows what happens and when things happen in the weather forecast office during a severe weather event. However, he is not normally in direct contact with schools. So in this regard he serves as a meteorological subject matter expert whose input is important.

Each emergency manager is responsible for different jurisdiction. Kurt is the emergency manager for Curtis County which is 558 total square miles with a population of about 256,000 (County Website, 2013). Jeremy's jurisdiction covers the city of Mintrow. Mintrow is 21.9 square miles located within Curtis County and has a population of about 56,000 people (City Website, 2013a). Bob's jurisdiction is also located within Curtis County and consists of the city of Norfolk. Norfolk is 189.5 square miles with a population of about 113,000 people (City Website, 2013b). It was important to have the emergency managers participate in the focus group so the group could hear what their roles and responsibilities are during a severe weather as well.

The participant from Mintrow Public Schools was the superintendent, Luke. Mintrow Public School District is located in the city of Mintrow and covers an area of 127 square miles, has a district population of 125,679 people and consists of 23 elementary schools, 5 middle/junior high schools, and 3 high schools. The average yearly enrollment is 21,818 students per year with 46.1% of students eligible for free or reduced lunches (School Report Card, 2011). Mintrow Public School District lies within two different counties.

Norfolk Public School District's participant was also the superintendent, Ralph. Norfolk Public Schools is located within the city of Norfolk and covers an area of 128 square miles. Norfolk Public School District consists of 16 elementary schools, 4 middle/junior high schools, and 2 high schools with a district population of 107,263 people. Average enrollment for the district is 14,456 students with 40% eligible for free reduced lunches (School Report Card, 2011).

Mintrow Norfolk Technology Center is a school that provides high school and adult student's career and technical education. There were two participants from this school system, Nikki and Howard. Howard is the facilities director and Nikki is the director safety officer. The superintendent was not available this day and she requested that Howard and Nikki take her place. During the 2013 fiscal year, Mintrow Norfolk Technology Center had 1149 long term students enrolled, of those students 453 were adults and 696 were high school students (School website, 2011).

Lightstow Public School District had one participant, Dennis, who is one of the school principals. The superintendent was not available and requested to send Dennis in his place. Lightstow Public School District is located in the city limits of Norfolk; however the district itself covers 57 square miles and has a population of 6,230 people. There is one elementary school, one middle school, and one high school with an average district enrollment of 1,230 students each year, 70% eligible for free and reduced lunches (School Report Card, 2011).

By having each of these stakeholders participate in phase two of the needs assessment, I was not only able to find what informational needs school decision

makers need to have, but the stakeholders will know what information is possible and what information is not possible. In addition, because the districts represented urban, rural, and suburban districts, it allowed for me to develop a broader perspective of processes and information needs. For example, if schools want the emergency manager to tell them the exact time a storm will occur, both the warning coordination meteorologist and emergency manager are present to tell them professionally and meteorologically that the exact time and location information is not possible. It also allowed for me to observe the collaborative interactions of the stakeholders so that I could use it in design of the problem based learning (PBL) training.

Data Collection

Participants of phase two were invited to a focus group meeting that occurred on November, 27th 2012 from 9AM – 2PM. Three different scenarios were brought up for a big group open discussion. The scenario was designed to mimic a storm that affected each of the districts involved which occurred earlier in the year. Each scenario was used to gather information about how and when decisions are made during different points of a hazardous weather day. Each scenario is described below. The scenarios were set up to convey a timestamp of a storm day. For example, scenario one is the earliest in time before the storm and scenario three is the closest to the storm. The entire focus group was audio recorded after consent forms were signed by the participants (see Appendix C for IRB approved consent form).

- Scenario One: At 10:00am, the National Weather Service releases a statement that today poses a significant severe weather threat and the public is urged to take precautions. At 11:30am, media stations repeat the statement.

- Scenario Two: 1:30pm - A tornado watch is issued for central Oklahoma, including Mintrow, Norfolk, and Lightstow. The watch emphasizes the potential for large damaging tornadoes. A thunderstorm has already developed southeast of Choco and a severe thunderstorm warning is issued for counties to the southwest, Curtis and Oasis Counties are not included.
- Scenario Three: 3:00pm Tornado reported by various sources moving into western Curtis County (just west of Norfolk). Tornado warning has been issued for Curtis, Oasis, Mckerter, and Caff Counties. Damage reports are being received by the Norfolk EOC. Parents are arriving at schools to pick up their kid(s) due to the weather and end-of-school day. Citizens arrive at schools to take shelter.

The researcher was the facilitator for the entire focus group. At the beginning of each scenario the facilitator asked what each stakeholder in the room typically did for the current scenario. Because of the open ended nature of each scenario, little facilitation and guiding questions were needed. The guiding questions that were asked were clarification questions or asking the participant to explain in more detail or expand their thought.

Data Analysis

Creswell's (2012b) chapter on analyzing and interpreting qualitative data was used as the main reference on how to conduct qualitative analysis. First the audio recording from the focus group was transcribed in its entirety. Next, the transcript was explored for common themes and patterns across the entire focus group (Creswell, 2012b). The transcript was read and researchers, one experienced with qualitative

coding and one new to coding, developed a list of themes that they thought might be present independently. They then met again and discussed their themes, similar themes were named inclusively, and dissimilar themes were discussed and accepted, combined into other themes, or discarded (Bogdan & Biklin, 1998). Next the transcript was coded according to following emergent themes that were reached by consensus: weather expertise, training information needs, stakeholders, superintendent communications and decisions, weather information from weather experts to superintendents, outside influences on decisions, and past experiences (Creswell, 2012b). The first 22 pages were coded with one experienced qualitative researcher, and myself with the first 22 pages used as 'training'. The next 10 pages were coded independently. After each coded 10 pages we went through to discuss differences and to make sure the themes were being coded consistently. After page 33, I coded the rest of the document myself in two different sittings, I went through and coded the last 34 pages on one day, on a separate day I went back through the last 34 pages again to adjust what was coded and to make sure I didn't miss anything. The experienced qualitative researcher then jumped around and spot checked 15 pages distributed across two different sections to make sure coding was consistent and to check for coding fatigue (Merriam, 1998). Below are the descriptions of each theme along with examples from the focus group.

Weather expertise. Weather expertise was defined as the process behind how weather information is used to make decisions. This category is specific to weather experts, Jason, Joseph, Kurt, Jeremy, and Bob. For example, "We are starting to watch boundaries because a lot of time it will, you know, will depend if it turns right…" is a statement from Bob, one of the emergency managers.

Communicated weather information. Communicated weather information was defined as what specifically was said to the stakeholders. This was anything from the weather experts sending e-mails to superintendents to a tornado watch or warning was issued. Jeremy states "I will take and e-mail the persons on the list…" as an example.

Stakeholders. Stakeholders were defined as anyone who participants mentioned is at the end of the communication chain or affected by the decisions made. This theme is not an explanation of the focus group participants themselves, instead it was additional people participants mentioned that make decision making during severe weather more complicated that would need to be considered when developing a PBL scenario that was realistic and complex. For example when participants discussed issues related to students, parents, bus drivers, etc.… these instances were coded as stakeholders.

Superintendent communications. Superintendent communications and decisions were defined as any weather information that is pushed out to the stakeholders. "Well we begin with notifying each school principal, then the superintendent notifies transportation…" is an example from Luke, a superintendent, of how the superintendent communication and decisions code was defined.

Past experiences. Past experiences were defined as any past event that was mentioned along with what decisions were made and how the past experience has shaped how they currently make decisions. For example, " I can tell you with what occurred last April if there's something in Lightstow or Choco (another city), I'm

probably going to put, we will probably take a serious look at sending a message out…" is a past experience mentioned by Ralph.

Outside influences. Outside influences were defined as any source where weather information is received from with the exception of from the National Weather Service. Local television stations, social media, and storm spotters would all be coded as outside influences. This theme included outside influences heard from either superintendents or emergency managers receiving weather information from beside the National Weather Service.

Training information needs. Training information needs were defined as requests mentioned from any of the participants of the focus group. For example when discussing bus drivers and what training is currently available, "...You know what we train them for, is not weather emergencies" was mentioned by Howard. This theme included not only training needs described by the superintendents but also training ideas that the warning coordination meteorologist or emergency managers suggested.

Results

A focus group was conducted on November 27, 2012 with a warning coordination meteorologist from the National Weather Service (Jason), three emergency managers (Kurt, Jeremy, and Bob), and school representatives from four school districts (Mintrow Public School District, Norfolk Public School District, Mintrow Norfolk Technology Center, and Lightstow Public School District).

The following themes were identified from the transcript: stakeholders, weather expertise, communicated weather information to stakeholders, superintendent

communications and decisions, outside influences on decisions, past experiences, and training information needs.

Stakeholders. Stakeholders were defined as anyone who is at the end of the communication chain or is sent information from any of our participants. Nikki the safety officer director for Mintrow Norfolk Technology Center stated that she sends information to "other schools and other people that I know here in Norfolk, like the banks, people I have personal relationships with." Parents, students, bus drivers, band directors, maintenance, custodians, and teachers were all mentioned as well. Additionally, "Athletic Folks for sure, cause they are outside anyway you know we are talking outdoor sports" was a statement from one of the emergency managers. One of the superintendents brought up the subject of public shelters and how their school is not a public shelter, but "here comes the people and their dogs". This would add the general public as a stakeholder as well.

Weather expertise. This theme described the weather decision process behind the National Weather Service and emergency managers and their decisions. In general, the participants sated there is a lot of interpretation involved in the decision making process. The emergency managers take what meteorologist say and interpret it for their area. When discussing scenario one, Jeremy, an emergency manager states "What I would do on a day like this is again, Jason [warning coordination meteorologist], the Storm Prediction Center, and the local forecast office would both be sending updates and providing information that then we normally take, or I do in Mintrow, and I am sure Bob does in Norfolk as well, I take what the meteorology that they are saying and try and interpret that for my 25 square miles in Mintrow." Bob from Norfolk emergency

management agrees and states “We have to dissect how that statement with that coverage applies locally, and in our case a lot of time in a deal like this, we are starting to watch boundaries”. When scenario two was discussed, the interpretations moved into how the storm was moving and where were the storms firing. “If it’s developed we are probably watching radar and seeing where the boundary is, what the movement is going to be…” was stated by Jeremy the emergency manager for Mintrow. It was also described that once storms started to fire and get closer that they start to focus their attention solely on the storms “At this point anything else that was on my desk is kind of going like this [motions to move everything out of the way]. We are focused on that and we are starting to pay attention with what’s going on, that’s what needs to happen.”

Communicated weather information to stakeholders. This theme was defined as specifically what was said to the stakeholders from the National Weather Service or from the emergency managers. There was a general agreement that before the storms started to get going (scenario one), emergency managers would send out an e-mail to a list of people to inform them about the threat of severe weather for the day; school superintendents are included on that list. Jason, the warning coordination meteorologist said “At this stage in the day we may be talking about broader terms like, west of the highway, or it’s not going to be Curtis County and Oasis County it’s going to be broader, but as you drill down toward the event and get closer it’s going to get more specific.” An example from Jeremy about what might be sent is “We may have some weather today, we are looking at 3:00 or after school or early evening or you know whenever I think it will be.”

As the severe weather starts to begin (scenario two) with a tornado watch issued and storms starting to the southwest, the emergency managers were asked if they would send more information to the schools at this point. The general response was “maybe”.

Jeremy stated,

> If it looks like it will be one of the impacts [talking about a school] then yes and probably on this one, they might actually get one [an e-mail] that’s just to him saying it’s starting to happen and timing looks like it might be right around end of school.

For scenario two, Bob also stated “I am going to talk about the impact on that storm in our jurisdiction and what we think we ought to do whether we are going to close schools or not close schools”. During the third scenario, there is a tornado reported and all of the emergency managers stated that the sirens would have been set off in each of their locations. Additionally the NOAA Weather Radio would have set its tone off indicating a tornado warning.

When it gets this close to the event, Jeremy mentioned what he might have put in an earlier e-mail while talking about a school band or athletic team traveling to a different location,

> I may e-mail the band director or even the athletic director and say you know if you have somebody going north today you might want to pay attention to what is going on. I’m probably not going to provide live direct support unless they ask, but again it’s the knowledge, the idea ahead of time.

This is important because he is stating the importance of having knowledge ahead of time and being proactive. He also was indicating how he uses the weather information provided to him by the NWS.

Superintendent communications and decisions. This theme was defined as the process of making decisions and how the decisions that are made are communicated to stakeholders. When discussing scenario one, emergency managers have stated they typically will send out a message to the superintendents in an e-mail. Once the superintendents receive this it doesn't take much for them to decide to disseminate the information as well. Luke, the superintendent for Mintrow Public Schools, stated, "Well we begin with notifying each school principal, and then the superintendent notifies transportation." Additionally Ralph from Norfolk stated something very similar,

> We notify the schools, through phone through e-mail, we also this past summer, and we would probably tell the schools that they need to have their radios on today. There is a forecast of a significant weather threat this, or whatever that would say you know, this afternoon, you need to be monitoring the weather, we will be monitoring the weather.

As the storms start to begin and a tornado watch is issued (scenario two), the main concern superintendents stated was safety of the kids. "Well it doesn't take a whole lot just to bring them inside and stop whatever activities. Again you want to be on the safe side rather than have some issues." Ralph said, "I would be really focused on monitoring the weather at that moment. I don't know that we would change anything yet at the school sites. But I would be on heightened alert and principals are on

heightened alert." Nikki stated they would start notifying staff about where the severe weather was in the state. "You kind of have to start targeting what schools may be in that area and begin to decide these are the actions we need to take because let's say that those schools on the west side of the district would be in line with something coming" was a statement from Luke. When the superintendents started talking about how information is communicated there were a variety of ways mentioned. E-mails, phone calls, automatic message systems were amongst the most mentioned.

Outside influences. Outside influences were defined as any weather information source that was not the National Weather Service. Superintendents receive weather information from a variety of sources. Some school building personnel follow TV station websites and their radar, they will turn on televisions to their favorite station covering the storms or they will flip between stations to hear differences in what each is saying. Howard stated that he likes just using the National Weather Service because "the marketing side of what they [television] may influence for TV ratings or for profit for business." Mintrow Norfolk Technology Center stated, "We pay for a 3rd party weather alert that comes in on a fax." Ralph stated they have a weather alert application from a private meteorological company in the city of Norfolk. Parents and students were even cited as sources of weather information. Parents will call in asking questions about activities for the night because they heard something on the television and "the kids too are all, it's a severe weather day, hey you know significant weather, significant weather, significant weather, they know that before they even come to school" was offered by Jeremy the emergency manager for Mintrow.

Past experiences. This theme was defined as any past experience that was mentioned along with the decisions or actions that were made and or have changed because of the experience. There were many different experiences recalled when participants were discussing some of the decisions they made. The experience most recalled was a recent storm that happened on April 13th, 2012. Luke mentioned "After last April we've spent time in the eastern part of our district trying to find a place to shelter a bus." When discussing confusion that has occurred during past events, Dennis had stated "Back to April when he sent the buses and you were going there crossing the highway and everything was good, he sent the buses out, now parents are calling there's a tornado on the ground." Because of this experience, there is likely to be more monitoring when there is weather in the immediate area. Howard related that you can't have hard fast rules because storms are not always going to come from the same direction. Jeremy agreed with this recalling a past event "May 3rd, I blew my sirens an hour before the storm hit. Which is not my protocol and is not the way I normally do things, but obviously the severity of the day [prompted it]." The fact that participants were recalling past experiences shows that what has happened in the past as affected how they think about storms which will in the future affect how they make decisions based on the information received. If information they receive is similar to a past event they are likely to recall the event and adjust decisions how they see fit.

Training needs. Training needs were defined as request for training mentioned from participants. This could be requests from the schools or ideas mentioned by the emergency managers. Additionally, some of the requests are practical and some are not, however I have included both in this section. Dennis mentioned that it would be nice to

have someone to call and ask "okay how, how dangerous is this for my district, should I keep them in the school. I just [want] someone to call. Communication is the big one we wanted." Communication was mentioned throughout the focus group in each section. This is not so much something that can be taught, but designing the training so both stakeholders can be involved provides the means for them to get to know who each other is. Howard mentioned,

> It's how on earth do we manage given your limited resources knowing that 10 am is one thing, 3 pm is a another whole animal because at 3 pm if we are saying storms are going to start at some point I think everyone of us knows that it's impossible to get a cell phone call out. We are not necessarily sitting at our terminals so that we can read e-mail we are not, you know there are not, there are all of these other communication issues that will come up and, and its natural I think to have people in the community have now identified and so, question here is if the schools become experts, then do you start getting calls from 50 parents.

This brings up not only the communication and the need for effective ways to communicate but also the need to training on proactive decision making so when you run into issues of not having a cell phone reception; it does not hinder your communication because you would have already made those decisions in advance.

Jason mentioned when gathering information,

> You are flipping around the channel 4, 5, 9 they are all saying something different and you have our stuff and you know it can be very confusing, so you

> can have information overload and conflicting information so that's a real dangerous thing, I think just because you are getting a lot of information, that's not always a good thing. Finding a source that you trust and a way to get that reliably is the key.

This says there is a need for training on reliable and trustworthy sources. Decision makers need to trust where their information is coming from and they need to know where they can get that type of information. Another need that was mentioned more than once was the need to get away from specific time-line of decision making. Each storm is different and has different attributes so saying you will make a decision based on a tornado watch or tornado warning is unrealistic. The training need is for people to understand how storms can move and overall basic storm attributes. Buses and bus drivers were also mentioned as key people who would benefit from training. Currently "what we train them for, is not weather emergencies" was stated by Howard, the facilities director for Mintrow Norfolk Technology Center. The types of training mentioned for bus drivers and athletic people were best practices for sheltering and basic storm spotting skills. Being able to pick out when it's "really bad." Lightning was cited as an important training need for athletic people. Jeremy stated "Lightning is the big one though because the storms kind of coming, oh we can get the last inning in real quick or the last whatever in, and sometimes it is real difficult to say now we have to stop and take cover." Training the decision makers on the complexity of lightning and how dangerous it can be is important.

How results of Phase Two Provided Guidance to the Design of Phase Three

Analysis of the focus group also helped me in the design portion of the ADDIE process when designing the PBL activities for phase three. The goal was to find information needs for school decision makers by an open discussion about what different stakeholders would do during each scenario. The activities were designed after the influence of phase one and would be combined with those findings to influence phase three, the PBL design. Although phase two was analyzed using themes from the transcribed data instead of pre-determined constructs as in phase one, for ease of reading and to able to see how the collected information is building towards the actual intervention, the discussion of how results of phase two provided guidance for phase three is presented using the same constructs already described in phase one: preparedness, weather information, communication, and past experiences.

Preparedness. There was little discussion about preparedness or policies amongst the superintendents during the focus group. The only policy that was mentioned referred to never sending students' home early due to a winter weather situation. Because school decision makers need to be able to make hazardous weather decisions proactively, the design of the PBL activities was focused on the lead up to the actual event as opposed to what happens at the time of the tornado.

Weather Information. School administrators discussed watching the different television stations before and during weather events and how the channels can provide conflicting information. Jason stated "You are flipping around the channel, 4, 5, 9, they are all saying something different and you have our stuff and you know, it can be very confusing." The discussion showed the influence that local media has on the decisions

that are made. Because local television channels are used to gather information during hazardous weather, this aspect was also incorporated in phase three amongst the information given to the school decision makers and emergency managers during the PBL activity.

Communication. It was shown from two different themes (communicated weather information to stakeholders and superintendent communications and decisions) that communication does occur between emergency managers and school district personnel in relation to severe weather events. Emergency managers stated they generally will send e-mails to districts within their jurisdiction and school superintendents stated they notify each principal and transportation. Superintendents had a variety of ways to communicate with schools. Each of the stakeholders talked about how they would communicate at different times within the weather event timeline, so this was used to designed appropriate time stamp cards which are discussed later on in the paper. However, superintendents never stated they communicate with other surrounding districts. This finding gave more inspiration to the heterogeneous grouping of the districts, mentioned earlier, among groups for the phase three, PBL activity.

Past experiences. Past experiences from phase two provided a lot of guidance toward the development of the PBL activity. One of the themes from phase two was outside influences. These were informational sources other than the National Weather Service. Since participants mentioned their past experiences of parents calling in asking about activities and that the students usually come to school knowing it is a severe weather day, both of these aspects were taken into consideration when designing the

happenings cards, described in detail later on in the paper, of the PBL activity. In addition to describing outside influences of weather information, participants also mentioned many different stakeholders that are involved throughout the decision making process. For example, Ralph shared that parents and the general public tend to show up looking to shelter while bringing their pets along with them at the school during severe weather. This was also used to design events that occur during a weather event that will be seen in phase three as happening cards.

Not only did phase two serve to provide guidance to the design portions of the PBL activity, it also allowed for triangulation of results from what was seen in phase one as well as providing reliability in the self-reported needs assessment survey of phase one (Creswell, 2012b; Spector 1994).

Chapter 5: Design, Development, & Implementation Part 1

Phase one and two were both part of the Analysis stage in the ADDIE instructional design process looking to answer the first research question of informational needs of school decision makers during severe weather. After the results were analyzed from phases 1 & 2, the next stages in the ADDIE instructional decision process are Design, Development and Implementation. These stages in the design process directly address the second research question of how the informational needs found from the survey and focus group can be used to make proactive decisions during severe hazardous weather are used to design effective learning. The steps from Morrison et al. (2011) instructional design model that fit within these stages of the design process are designing the instruction, developing materials, and then implementing a pilot test. This chapter describes each of these components with its relation to the current study.

Design

The first element they described in the design process was instructional objectives. This is the part of the process where the designer specifies exactly what the learner must master. The following are the objectives for the school decision maker workshop.

Given a scenario and real life weather data in a structured problem based learning (PBL) environment,

1. Stakeholders of the hazardous weather decision making process will be able to describe concerns, complexities, and informational needs of other stakeholders within the decision making process.
2. Participants will apply past experiences to the decision making processes.
3. Participants will compare policies and procedures with other stakeholders in the decision making process.
4. Participants will communicate with other stakeholders in the decision making process.

The next stage Morrison et al. (2011) described instructional strategies and designing the message as two more components of the instructional design process. This study uses the instructional strategy of PBL. To do this, three activities were designed using real severe weather case data that has happened previously in different parts of the country. It was designed to have two teams amongst the participants. One team consisted of emergency managers and the other team of school decision makers. The participants were walked through the severe weather cases by being given critical time stamps on an index card. This information resembled the same types of information that they would receive on a typical weather day. For example, emergency managers were given the real convective outlooks and mesoscale discussions from the day with the critical time stamp cards and school officials were given simulated daily schedules for the day with the critical time stamp cards. In addition to the critical events, each team received 'happenings' cards. These cards presented things can happen during a severe weather day (e.g. Parents are calling asking if the baseball games are

cancelled tonight because of the weather). The types of things located on these cards came from the phase two focus group discussions.

Designing the message had three components to it: pre-instruction, signaling text, and use of pictures and graphics (Morrison et al., 2011). First the designer designed an introduction to prepare the participants for the instruction they would receive. This was designed as a verbal introduction first from the director of the Oklahoma Climatological Survey followed by the facilitator explaining the PBL activity. The second step was the designing of the text that was going to be used. This was the design of the time stamps cards that were mentioned above. It was during this point the designer decided the facilitator would distribute the cards one at a time instead of leaving the cards for the entire activity at each table, a decision that decided the sequence of instruction. The last portion of the designing the message was the use of Google maps, county maps, and radar during each activity. The designer made each available to lessen cognitive load throughout the activities so participants did not have to try and remember where the area of responsibility was located.

The part of the instructional design process where instruction is scaffolded is the content sequencing stage. To exploit participant's cognitive dissonance (Ormrod, 2012), the three activities comprised of only two past severe weather cases. For the first case, participants played the role of a stakeholder other than their own, that is, the school officials were given the information and tasks of emergency managers and vice versa. This allowed them to gain an understanding of the other stakeholder's roles and what they do during severe weather. For the second case they were then moved back to their

native roles and participated in the same case as the first activity. Finally they participated in the final activity which was a different past severe weather case.

In addition to participating in different roles amongst the cases, during Activities A and B the participants were intermixed amongst participants from other districts. This was designed to give the participants an opportunity to discuss with other districts and hear other points of view and past experiences others outside of their district might be having. It was also the hope with the design to open up communication avenues for the future. By gaining a relationship with someone outside of their district, participants have another resource they can use of call for future severe weather events. Lastly, Activity C was designed to put the school decision makers back into their own school district teams. This was designed to simulate what would happen in their real life and who they would be talking with during a future severe weather event. An overview of the activities is shown below.

- Activity A: This was the pilot tested activity where the emergency manager team played the role of the school decision maker, and the school decision maker team played the role of the emergency manager. Since there were school decision makers from more than one district attending, the districts were split evenly amongst two different groups (please see Appendix D for activity materials).
- Activity B: This was the pilot tested activity from Activity A. However for this activity, each team played the role of their own profession with the school decision makers from each district intermixed amongst the problem solving groups (please see Appendix D for activity materials).

- Activity C: This was a similar scenario with the participants grouped in their own profession but this activity they were working amongst the people in their districts with their associated emergency manager (please see Appendix E for activity materials).

Development

Following the design phase, Morrison et al. (2011) describe development of the instruction as the next step in the instructional design process. This is when all of the parts from the design phase are put together to produce the instructional materials. For the current study, I found the archived weather data, convective outlooks, mesoscale discussions, tornado watches, radar, and tornado warnings online and I developed the critical event and happenings cards based on the real time data from actual events. It was at this point I discovered how many time stamp cards would be needed for each activity based on what information was made available and at what times on the actual day of the event. In order to keep participants moving throughout the activity, it was decided each time stamp card would have a time limit of five minutes. This also mirrors the decision making process in a real weather event when decisions must be made quickly. It was also during the development phase that the evaluation instruments were developed. On the back of each time stamp card, participants were asked to answer five questions:

1. What actions do you take?
2. Why do you choose to take those actions?
3. On a scale from 1-10, how concerned are you? (1= Not concerned at all and 10=Completely concerned)

4. What information do you want and need at this point?
5. On a scale from 1-10 how confused are you? (1= Not confused 10= Completely confused) What is confusing you?

Implementation Part 1 (Pilot)

After the case to be used in Activity A and B was fully developed, a group of volunteers whose backgrounds mirrored the target audience (three school decision makers and two weather knowledgeable) were asked to participate in a prototype and pilot study of the activity. They met and had their roles explained to them and then the activity was run as if it were the real training. They performed Activity A that occurred on the day of the training, where emergency managers took the roles of school personnel and school personnel took the roles of emergency managers. The participants consented to being recorded so they were asked to think aloud (Morrison et al., 2011) and share any confusion or frustration with the researcher so that it could be modified for the future group. After the activity was completed, debrief questions were asked to test possible questions for the future intervention and to ask if there were any specific points of confusion. These questions were developed as the researcher observed the pilot test activity and thought of questions to ask the participants based on what was heard and observed. These debrief questions proved to be useful and they lead to formal debrief questions being developed for the actual implementation.

During the pilot test, the participants were asked to talk aloud and notes were taken about the discussions and questions that they had. The audio tapes were listened to after the pilot test and additional observations were made. These observations and notes were used to refine the activity for the full implementation.

From this pilot test, the activity was refined in the following ways. First participants wished the time stamp card had day of the week included on it instead of just the date and time, this was added to each time stamp card. One of the time stamp cards for the school decision makers had their daily schedule written on it. There was confusion as to what it meant so the card was reworded and there is more explanation written on it. Additionally, during the debrief, participants who played the role of emergency managers stated that some of their actions would to be to contact a stakeholder (school or hospital). During the exercise, while told they could send a message, they never did send one to the school. It was a design concern, that if prompted to send messages, they would send them, but not because it is how they would react in the real situation. The participants suggested having a facilitator listen in and if they discuss sending a message giving them a way to do so. From this, it was designed to have a facilitator sitting at each table where when the group decided to send a message the facilitator handed the team a slip of paper asking the following.

1. What is the date and time on your time stamp card? What role are you playing?
2. How would you like to contact them? (E-mail, Phone Call etc….)
3. What message would you tell them?

The team wanting to communicate then filled out the piece of paper and the facilitator either handed it to the stakeholder if it is an emergency manager or school personnel. This allowed for added information to the schools if that is what the emergency manager, or school decision maker decided and it added to the happenings cards that emergency managers and school decision makers received, thus making it

more realistic to a day's event. Participants also had a difficult time knowing when they could look at radar so radar prompts were added to the time stamp cards that indicated radar was available for them to look at. Additionally it was felt that there needed to be more happenings cards for the emergency manager team so additional cards were added for that team as well. Lastly, a map of the town the school decision makers were responsible for was included as well as a map of the county the emergency managers were responsible for. This was done since the participants were not familiar with the area of the case. This way they knew what area they are responsible for when referring to the weather data they received. The informal debrief questions were formalized for the full implementation (See Appendix F for debrief questions used for full implementation) and a pre/post survey was designed (See Appendix G) to be able to capture learner characteristics of the participants the day of the implementation.

The systematic process of using an instructional design model facilitates using the information from the needs analysis survey and focus group data to meaningfully develop a learning activity. This directly addressed research question two of how does one design effective learning to address the informational needs of the school decision maker in order for them to make severe weather decisions proactively and it is assessed by the evaluation phase of the instructional design.

Chapter 6: Implementation Part 2 and Evaluation (Phase Three)

Phases one and two of the study were a part of the Analysis stage of the instructional design process in which they answered the first research question of what the crucial informational needs are for decision makers to make proactive weather decisions. The second research question was then addressed in chapter 5 by using a systematic approach to design the problem based learning activity using the informational needs found from phases one and two. Phase three of the study was the actual implementation of the problem based learning (PBL) activity as a training technique. This part of the study includes both the full launching implementation of ADDIE and the Morrison et al. (2011) instructional design models as well as the summative evaluation of the PBL activity. Phase three addresses research question three of whether school decision makers understand the complexities and information needs of other stakeholders in the decision making process. Phase three also addresses research question four which asks whether PBL is an effective way to train school decision makers to make proactive weather related decisions during severe weather, and if so, in what ways is using PBL effective.

Participants

Participants of phase three consisted of 16 participants. There was one emergency manager, two school emergency managers (school personnel who had attended OK –First training) , and 13 school decision makers. Participants were from one of three districts invited: Norfolk Public School District, Mintrow Norfolk Technology Center, and Lightstow Public School District. The school decision makers were a mixture of superintendents, principals, teachers, coaches, transportation

directors, and maintenance directors. With participating districts being the same as phase two, there were only three participants in phase three that also participated in the focus group of phase two (two school emergency managers, and one school decision maker). Table 13 shows a breakdown of how many participants were from each district.

Table 13
Number of PBL participants from each district or emergency management

Emergency Management or School	# of Participants
Blue Emergency Management	1
Norfolk Public Schools	5
Mintrow Norfolk Technology Center	5
Lightstow Public Schools	5

The workshop took place on June 6th, 2013 from 9AM-4PM. The overall arrangement of the day was as follows:

- Introduction
- Activity A (1 hr) – Schools mixed and acting as EM's, EMs acting as schools. – Henryville Case
- Activity B (1 hr) – Schools mixed acting as schools, EM's as EM's – Henryville Case
- Lunch (1 hr)
- Activity C (1 hr) – Schools arranged with coworkers and EM's as EMs – Kansas Case.
- Feedback on Website.
- Conclusions and Thank Yous.

Data Collection

Participants were assigned to their groups based on their roles and affiliations for each of the problem based activities. There were four tables total with emergency managers sitting at one table and then educational personnel from the three districts that attended were mixed on the three other tables. These educational personnel were split between tables so that participants could learn how other districts made decisions as well as share other's past experiences during hazardous weather. Sharing experiences amongst participants is a key component of PBL learning (Jonassen & Hung, 2008). When the participants arrived on the day of the workshop, they received folders with their names on them as well as table assignments for each activity. In their folders, there were an IRB approved informed consent form (Appendix C) for them to sign to participate in the study as well as a questionnaire to fill our prior to the beginning of the activities (Appendix G).

To begin, participants were welcomed by Oklahoma Climatological Survey personnel and given an overview of the day. In addition to the activities that were planned to take about four hours (with a break for lunch), participants were going to give feedback on a possible website for schools use in the future to aid in their weather decision making. After the introduction to the day, the activity and the volunteers that were helping to facilitate the activity were introduced. Each activity had an employee from the Oklahoma Climatological Survey seated at the table to record the conversation and deliver any messages between tables if requested.

Activity A. To begin Activity A, each table was given a sheet of guidelines and maps (See Appendix D for activity materials) as well as a few blank time stamp cards and happenings cards that were used to explain the activity. For Activity A, the emergency manager table played the role of school decision makers, and the school personnel tables played the role of emergency managers. The case chosen for this activity was March 2nd, 2012 with a tornado that occurred in Henryville, IN. There was one school decision maker group comprised of the emergency manager and two school emergency managers, and three emergency manager groups (comprised of mixed school decision makers present). It was explained for Activity A, that the school decision makers were responsible for the schools located in Henryville, IN and the emergency managers were responsible for Clark County, IN of which Henryville is located. Participants were told they would receive time stamp cards in intervals of five minutes. Each time stamp card contained information and a time at which that information became available. For example, the first time stamp card for Emergency Managers said,

> "You are watching your favorite news station and hear the following: 'We are expecting some severe weather on March 2nd. We will keep you updated here on Channel 11. Visit our website for more and tune in at 11 tonight.' You look online at the Storm Prediction Website and see the following Day 3 Outlook that was issued at 3:30 AM this morning."

The first time stamp card for school decision makers said,

"You are watching your favorite news station and hear the following: 'We are expecting some severe weather on March 2nd. We will keep you updated here on Channel 11. Visit our website for more and tune in at 11 tonight.'"

Regardless of group assignment (emergency manager or school), during the five minutes each group was to discuss the card and then answer the following five questions on the back of the time stamp card as a group:

1. What actions do you take?
2. Why do you choose to take those actions?
3. On a scale from 1-10, how concerned are you? (1= Not concerned at all and 10=completely concerned)
4. What information do you want and need at this point?
5. On a scale from 1-10 how confused are you? (1= Not confused 10= completely confused) What is confusing you?

Additionally it was explained that after the yellow time stamp cards were distributed another set of cards called happenings cards could be distributed. Happenings cards are anything additional that could happen during the day when there is a severe weather event. For example, the first happening card both groups received was "Oops, you fell asleep and missed the 11 o'clock news." Not every timestamp card had an associated happening card, nor did both groups receive happenings cards at the same intervals. To see happenings cards in Activity A see Appendix D. The time and frequency of these cards were based on the kind of interactions people in each role might receive during

the storm event process. For example from phase two, one participant had stated that they are not always able to sit and watch e-mail all day indicated they might not receive and e-mail with weather information at the exact moment it is sent. In addition to telling them they had five minutes for each time stamp card, a timer was put up on the projector so they were able to tell how much time they had left. The facilitator at each table collected each time stamp card with their responses and saved them to turn them in. There were 10 time stamp cards for Activity A so the activity took just over 50 minutes. After the activity was completed, participants were asked the following debrief questions, which were developed after the pilot test implementation, in a large group discussion format:

1. What is hard about the school decision maker's job? (Asked to the emergency managers playing the role of school decision makers).
2. What is hard about the emergency manager's job? (Asked to the school decision makers playing the role of emergency manager).
3. What do you know now about the other role that before this activity you didn't?
4. What information did you wish you had playing the roles that you were?
5. Given the specific weather information, was it is easy to make a time call and know what to do?
6. After playing the role of an emergency manager, thinking about future events, does going through this activity change how you will interact with emergency managers? Why? How? (Asked to the school decision makers).

7. After playing the role of a school decision maker, thinking about future events, does going through this activity change how you will interact with school decision makers? Why? How? (Asked to the emergency managers).

After Activity A, all of the groups were given a break. Some discussion continued but it was not encouraged or discouraged. After 15 minutes, the participants returned to complete Activity B.

Activity B. Activity B was structured in the same way Activity A was. The only difference was the participants went back to their native job related roles but were still in groups that mixed up the school district personnel. The emergency managers now played the role of emergency managers and the school personnel played the roles of school decision makers. There was one emergency manager table comprised of the emergency manager and two school emergency managers, and three school tables with the school decision makers located at them. Activity B used the same case of Henryville, IN where the school personnel were responsible for the schools in the town of Henryville, IN and the emergency managers were responsible for Clark County, IN. The events and happenings cards were exactly the same but the participants were now playing the roles that were most related to their jobs. After the activity was finished, the following debrief questions were asked to both groups:

1. What do you know now about the other role that before this activity you didn't?
2. What information did you wish you had playing the roles that you were?

3. Given the specific weather information, was it is easy to make a time call and know what to do?

At this point, participants were given a one hour lunch break. Discussion of the topics continued but was not recorded and was neither discouraged nor encouraged.

Activity C. Activity C was structured the same way with the time stamp and happenings cards as activities A and B. This time, the severe weather case that was used was from May 4th, 2007 in Greensburg, KS. Another change from activities A and B was the school personnel were now located at tables grouped by their own district. For this activity, the emergency manager table was only the one emergency manager in attendance and the school emergency managers went back to collaborate with their districts. This is because I wanted the participants to now make decisions amongst who they typically would be talking with during a real severe weather event. There was one table with one emergency manager and three tables with school personnel. Additionally, this severe weather event had 11 time stamp cards instead of 10 so the activity took about 60 minutes to complete. After the activity was completed the following debrief questions were asked in a large group debrief.

1. After playing the role of an emergency manager, thinking about future events, does going through this activity change how you will interact with emergency managers? Why? How? (Asked to the school decision makers).
2. After playing the role of a school decision maker, thinking about future events, does going through this activity change how you will interact with school decision makers? Why? How? (Asked to the emergency managers).

3. As a whole, what did you think about the experience today? (Asked to both groups).

At the end of the activity, the participants were asked to complete a post questionnaire (Appendix G).

Data Analysis

Back of the Cards. There were four sets of cards for Activities A, B, and C each with 10 cards in a set. The answers to the questions on the back of the cards were entered into an excel spreadsheet. Each question and set of cards was looked at independently for common categories or key words in their answers (Creswell, 2012b). For the question referring to what actions participants would take, there were two common categories. The first was weather responses and the second was communication responses. In response to why they would take such actions, there were three main categories: forecast, threat or risk, and warning issued. When answering what information was needed there was just one category and that was weather updates. The two numerical rating questions from the back of the cards were placed on a graph and analyzed looking for trends between each group.

Recordings from Tables. There were 12 total recordings of approximately 50 minutes each. Recordings were listened to and notes were taken where the researcher felt there were particularly interesting conversations or discussions and where past experiences and tornado misconceptions were heard. The areas noted during the re-listening of the recordings were listened to at length and transcribed (Creswell, 2012).

However, while the participants were assigned to each table, many of them were unfamiliar to the researcher, so roles were often discernable from their responses, but detailed naming was not possible as was done in phase 2. From the transcription, themes were found amongst all 12 recordings. Below are the descriptions of the themes with examples from the PBL activity. These were coded by a single coder. However, an experienced qualitative researcher observed the PBL activity and also listened to the recordings to verify the findings and that the themes chosen represented the discussions recorded (Creswell, 2012b).

Past experiences. Past experiences were defined as any previous event that was discussed during the activities. Participants discussed what actions they took during the past experience and how they related it to the current activity. For example, a school decision maker stated, "The year before, we didn't have a situation, we were not as well prepared…" is a past experience from one of the school decision makers.

Severe weather misconceptions. Severe weather misconceptions were defined as statements made because of reasons that were meteorologically incorrect. For example when discussing tornadoes and how one knows there is a tornado, one school participant stated "…there's no tornado if there isn't a siren."

Preparedness. Preparedness was defined as anytime a participant referred to policy that was currently in place or sheltering procedures. "I think the procedure is lockdown" is an example from a school participant when discussing what to do when a tornado warning is issued.

Decisions. Decisions were defined as discussions that contained a specific decision point during the activity. For example, school decision makers had to decide if they were going to send students home early or not. While playing the role of school decision maker, an emergency manager stated, "Buses leave at 2. We are at 12:30. Well, we may get elementary home."

Confusion. Confusion was defined as any point the participant stated they were confused or didn't understand the information given. For example, one school participant stated, "I haven't even looked at this mesoscale deal. Anyone know how to read this? Do you know how to read it?" This was during the activity where school decision makers were playing the role of emergency managers.

Information Needs. Information needs were defined as anytime a participant stated they wish they had a specific type of information. For example one school participant stated, "I want to know how far out it is, its travel, its movement, estimated time of arrival."

Learning. Learning was defined as points during the discussions where participants stated they were learning something, or when participants were explaining or answer a question another participant had. For example a school decision maker asked, "I don't know how many spotters to know whether or how they communicate, you know what I mean? Do they communicate by e-mail or cell phone call?" A participant at the same table said spotters communicate by "Radios."

Debrief Questions

First the audio recordings from the debrief questions were transcribed in its entirety. Next, the transcript was explored for common themes amongst the responses of each question. After common themes were found, the transcript was coded according to the following: challenges of other stakeholders, new knowledge, ease of making decisions, and future events.

Challenges of other stakeholders. Challenges of other stakeholders was defined as anytime a stakeholder mentioned difficulties they had while play the role of the opposite stakeholder. For example when explaining what it was like to play the role of an emergency manager, one school participant stated, "We couldn't understand how to read all the information."

New knowledge. New knowledge was defined as participants mentioning when they had learned something they had not known prior to participating in the activities. In response to asking what they knew now about other stakeholders that they didn't before one participant stated, "Their job is really hard."

Ease of making decisions. Ease of making decisions was defined as anytime a participant responded about whether it was easy or difficult to make decisions. A school participant while playing the role of emergency manager stated it was difficult to make a decision because they didn't always have the information that they needed.

Future events. Future events was defined as participants mentioning what they would do in the future now having gone through this PBL activity. For example, the emergency manager stated "I plan to get a little closer to schools instead of just taking a plan and putting it on a shelf."

Pre/Post Questionnaire

The pre/post questionnaire had a total of ten questions. First, each question of the pre questionnaire was analyzed to see if there were any common categories or emerging themes from which the respondents answered (Creswell, 2012a). Secondly, each question of the post questionnaire was analyzed to see if there were any themes or common categories from which the respondents answered, then the pre/post questionnaires were compared to find differences.

What type of information is readily available to you during a severe weather event? This question yielded five different categories: phone, internet, radar, weather radio, and television. These were all categories that were mentioned more than once amongst the participants from both the pre and the post questionnaire.

What types of information do you need during a severe weather event? This question yielded three categories: location of storm, severity of the storm, and updates. Participants wrote they needed the location of the storm or the time of arrival, both of these were categorized as location of the storm. Participants wrote either just severity or severity of the weather and these were both categorized as severity of the storm. Lastly updates were mentioned as alerts, frequent weather updates, or current weather updates, these were all categorized as updates.

What are your concerns on a severe weather day? This question yielded only one category: safety of students and staff. This was mentioned as keeping kids safe, student safety, or safety of personnel. All of which were categorized as the one category.

What kinds of tasks must you do on a severe weather day? This question yielded two categories: monitor weather and preparedness. Participants mentioned monitor and seek info and updates which were both categorized as monitor weather. The preparedness category was made from participants mentioning their action plan, prepare communications, or precautions.

What kinds of distractions are present for someone in your role during a severe weather event? This question yielded two categories: address students or personnel and parents or public. Students and staff were categorized as one category because they were mentioned together in the responses of the participants. Therefore they were categorized as one category within the school system. This was also the case for parents and public. As they were outside of the school system, they were categorized together as one category.

What type of information is readily available to other decision makers during a severe weather event? This question yielded five categories: did not answer or confused, phone, television, weather information, location of emergency manager information. The "did not answer or confused" category exists because the question was left blank or the participant answered it for the wrong stakeholder. For example there were times a school participant answered the question as "student attendance" clearly speaking about a different school stakeholder instead of the emergency manager as instructed in the directions. The other four categories were made because those four specific words were used more than once amongst the participant's responses.

What are the types of information the other decisions makers need during a hazardous weather day? This question yielded two categories: did not answer or confused and storm information. The "did not answer or confused" category was used for the same reasons as mentioned previously. The participant either did not answer the question at all or they answered about the wrong stakeholder. Storm information, storm location, storm severity, and storm probability were all mentioned within the responses. However, each of them did not authorize their own category because there was not one that was mentioned more than the others. This is why it was made a general category of storm information.

What are other decision makers' concerns on a severe weather day? This question yielded two categories: did not answer or confused and emergency manager's activities. Did not answer or confused was categorized for blank or unrelated answers. Emergency manager activities included sound sirens, opening roads, community safety. Because there was not one overarching response amongst the examples the category emergency manager activities was made a general category to include all of the responses that mentioned the different aspects of an emergency manager's profession.

What kinds of tasks must other decision makers do on a severe weather day and what kinds of distractions are present for the other decision makers during a severe weather event? These two questions only yielded the "did not answer or confused" category. Responses varied widely showing there are many tasks and distractions amongst the different stakeholders. Because of the varied response there were not enough commonalities to form another category.

Results

Phase three was the PBL activity for school personnel and emergency managers. It was comprised of three activities. During Activity A, participants assumed the roles of a different stakeholder other than their own within groups that were intermixed among districts. Activity B they assumed their native professional role within groups that were intermixed among districts. Lastly, Activity C they assumed their own native role within a group comprised of participants from their own local districts. Phase three relied on four different data sources to understand the interactions and decision maker process the participants engaged in during the PBL activity. The first source was answers to questions on the back of each time stamp card. The second source was recordings from each table for each activity, looking for common themes amongst discussion. The third data source was the participants' responses to debrief questions. Lastly, a questionnaire was administered prior to the activities and after the last activity concluded. This section reports the results amongst each of the data sources independently.

Back of the Card Answers. During the activities, participants were asked to answer questions on the back of each time stamp card. There were two different types of questions, short answer questions and rating questions. For the short answer questions participants were asked to describe or list actions they would take or information they would want or need at the given time stamp card. The rating questions asked them to rate how the felt on a scale from 1-10. However, after listening to the recordings from each table while looking at the answers to the questions, it was found that even when groups discussed actions, or information they wanted, they did not

elaborate on the cards indicating they may not have had enough time to write out their full thoughts, or they may not have known what types of information they were supposed to list on the cards themselves. Discussed here are the topics that were in their answers, but this is much better represented in results of the recorded discussions.

One question asked what actions the participants would take at the specific time stamp. The most common responses to what actions the participants would take was to monitor weather or weather awareness and communicate with the personnel and staff. For example one card read, "Communicate with activity sponsors. Watch weather and send weather updates to administrators." Another table wrote, "Email tornado watch at 11:30am." Table 14 shows a breakdown by activity of how many times monitor weather/weather awareness or communication of some type was written. In response to why they would take such actions, participants mostly wrote it was because of the forecast, threat or risk, a warning was issued, or just to be prepared and for safety.

Table 14
What actions would you take?

	Activity (n=40)		
	A	B	C
Monitor Weather	13	14	11
Communication	21	23	23

Another question asked participants to rate their level of concern on a scale from 1-10. Figure 11 show graphs of ratings for activities A, B, and C respectively. If you look at graphs for Activities A and C, you will notice a lowering concern at time stamp 4. This has to do with the real world weather data they received. The threat decreased, so their concern also decreased. Looking at the general trends and comparing school tables with emergency manager tables from each activity the

trends are very similar. However, comparing time stamp four for the emergency manager role in Activities A and B, you will notice in Activity B the emergency managers concern level did not drop. This is because Activity B is when participants were back in their own professional roles so the emergency managers were playing the role of emergency managers and are used to fluctuation and uncertainty of severity when receiving real world weather data.

Figure 11. Level of Concern Graphs of Activities A, B and C

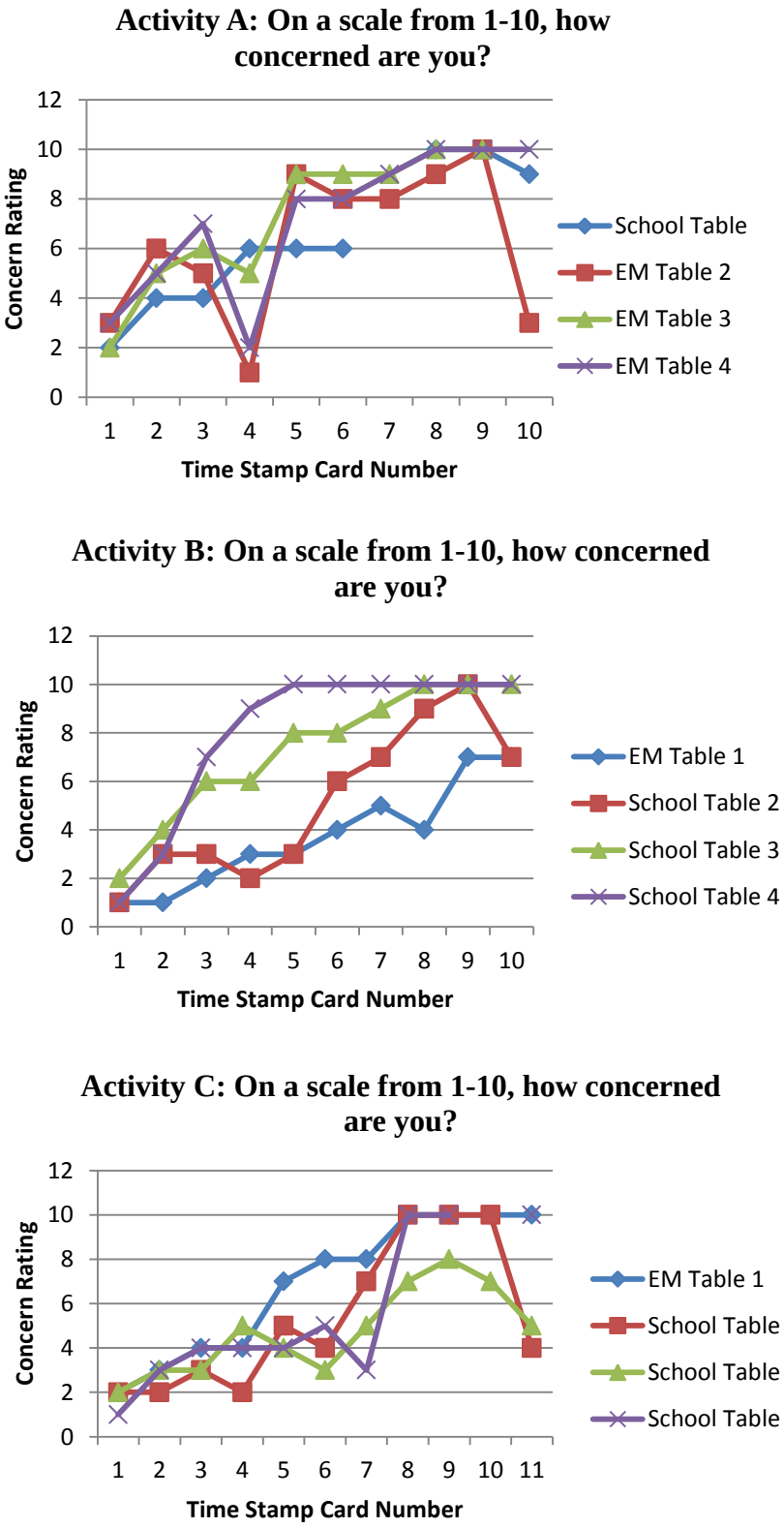

Figure 11: Participants ratings of their concern levels during activities A, B, and C

The most common response to the question about what information was wanted and needed at any given point was continuous updates. Participants wanted to know where the storm was located, how fast the storm was moving, the time of arrival to their area, severity of the storm, and the reports of where damage was occurring so they could relate it to their area. “Timeline, severity of storm” and “How fast is it moving? What is the time of arrival?” are a couple of examples schools had written on the back of their cards. Another aspect of information wanted and needed was clarification of weather terminology. One table wrote “Clarification of maps and what they mean.” This was specific to Activity A when the school decision makers were playing the role of emergency managers. They realized with the information they were given; they didn’t know how to read it and wanted clarification of what the maps and the terminology meant.

Figure 12 show the results from the last question about being confused. However, since the groups did not answer what they were confused about there are numerous possibilities for where their confusion may lay. It could be confusion with the activity, the storm, their role or other variables. If you notice Activity B showed much less confusion because it was the second time they were working with the same scenario, there were more clear on how the activity would progress, and they were back in their native professional roles and their cognitive dissonance was likely decreased.

Figure 12. Level of Confusion Graph for Activities A, B and C

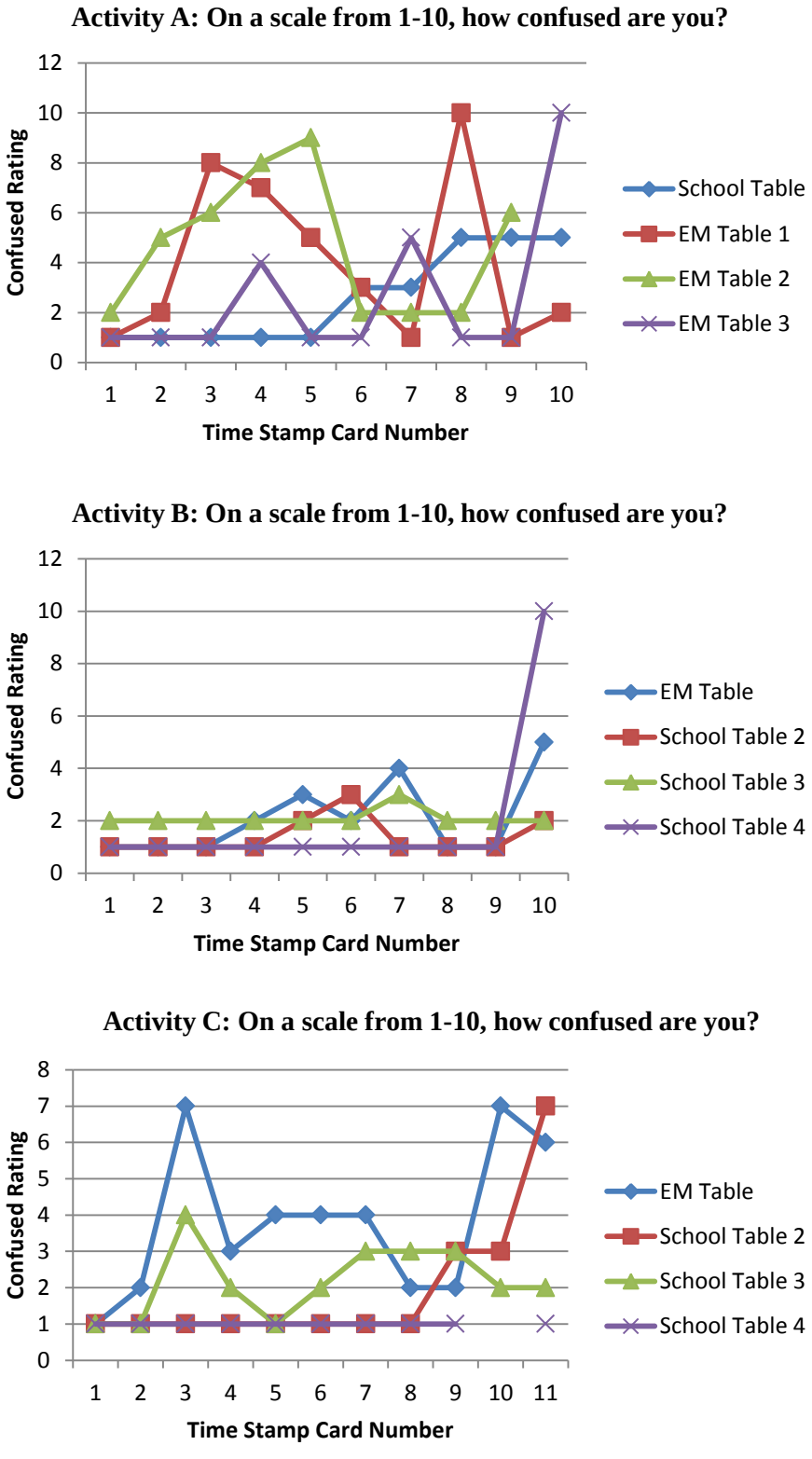

Figure 12: Participants confusion levels for activities A, B, and C

Recordings from Tables. There were four tables with three to five people located at each table, with the exception of Activity C when there was only one emergency manager at the table. While each participant was assigned to each table, no formal numbering was used to identify them on tape. Whenever possible, they are identified by their role but no statements are specifically assigned to a participant. Seven themes emerged from the recordings taken from each table: previous experiences, severe weather misconceptions, preparedness, decisions, confusion, information needs, and learning.

Past Experiences. Past experiences were defined as discussions about a past event and how it affected and related to the scenario in the activity. One school decision maker brought up a past experience with a storm in reference to holding buses because of imminent severe weather,

> The year before, we didn't have a situation, we were not as well prepared we didn't have the radios and the buses, we went ahead and put the kids on the bus, they got on the other side of the interstate and had to take shelter at an elementary school.

There were many discussions about what time of year severe weather occurs, which way storms move and using what they have seen in the past while trying to figure out the current situation. Activity A and B used the case of Henryville, Indiana which had a tornado occur on March 2nd. Early in the activity the participants were given a card that was dated February 29th, 2012. One school decision maker stated "It's February, there can't be tornadoes…" while playing the role of emergency manager.

When discussions occurred about directions that storms move, a recent event was brought up and one school decision maker stated the following while playing the role of emergency manager,

> That's another thing we see here. Most storms we see around here go from, you know, up southwest to northeast, but lately storms have been going straight east and slightly south. Is there something to learn from that?

During the same activity the emergency manager shared,

> By looking at radar you are not overly concerned. Just because of another scenario from the previous, May 20, it's going to go north and take a right turn right down 4th street, and then there was the El Reno one went south.

During each scenario, the participants playing the role of school decision makers had to make decisions about after-school activities. One table was trying to remember when their superintendent cancelled activities during a recent event. They were using what they remember from the event to figure out if it was too early in the day to cancel after school activities during the current activity. The following is a conversation between school decision makers while playing the role of school decision makers,

> "He got on the radio [superintendent] and said all activities are cancelled..."
>
> "What time was that at?"
>
> "I think it was before lunch because I think the kids…"
>
> "Oh yea, it was probably 9 am."

"So do we want to cancel activities at this point [within the current activity]?"

Severe weather misconceptions. There were many instances where general knowledge about severe weather and storms, basic knowledge assumptions, were stated incorrectly during the group discussions exposing severe weather and storm misconceptions. There were two main topics in regards to this theme, tornado sirens and tornadoes after sunset. One of the groups had a discussion about whether a siren was heard when their weather radio went off for a tornado warning. While playing the role of emergency manager, one school decision maker stated,

> I watched the fence go, I watched a few roofs go and then I'm like, this isn't a tornado we haven't heard the warning sirens, there's no tornado if there isn't a siren.

Another school decision making group had the following conversation while playing the role of school decision maker,

> "Do they sound sirens when there is all clear? Because sometimes they siren more than once."
>
> "Cause I wonder, there have been three times"
>
> "Well I didn't know 'cause we have them and I'm not really clear what the sirens mean."

Activity C was a previous severe weather event that occurred during the evening hours. When a school decision making group was discussing their actions while playing the role of school decision makers, one participant stated "If we can wait till dark, we

got it made." Another stated "If a tornado hits the ground at 9:15 pm, its dark, you know it's about over with, they die out pretty quick." This indicates that participants do not think tornadoes occur after dark and if there is one occurring after dark, it is not strong and it will not last long. This, however, is not true. For example, an F2 tornado with wind speeds estimated at 155 mph hit Iowa City on April 13th, 2006 at approximately 8:30 pm (National Weather Service, 2006).

Preparedness. Participant discussions which talked about sheltering and sheltering policies were coded as preparedness. Sheltering discussions came up when discussing about students, staff, general public, and bus drivers knowing where to shelter if there is an event happening while they are enroute. There was only one school decision maker table that talked about sheltering policies while playing the role of school decision makers. One participant stated from this table "I think the procedure is lockdown." When discussing what happens when a shelter situation occurs after school has dismissed and buses are on their routes, one participant from the emergency manager shared their experiences while playing the role of school decision maker,

> What we tell our bus drivers, all we can do is assume what we do, all our drivers after the deal a couple years ago we have all of ours, they have already mapped the ones who run regular routes, they already have places in mind to go.

Two tables of school decision makers discussed sheltering location at their schools. While playing the role of school decision makers, one participant stated, "They are not actual [shelters], we have what are called safe rooms." A different school decision

maker table during the same activity had a discussion about what their school was made of, how the concrete was poured and what the rating of their new school was.

> "What is the safe place for students at your school?"
>
> "Halls."
>
> "Hallways."
>
> "The high school actually now we have built up concrete buildings actually so they are rated at about 120 to 140 mph 'cause some of them have concrete roofs. The high school the north end of the high school actually has berms up the side of those walls and one of the classrooms there doesn't have any windows."

Another discussion that repeated at several tables, both school decision makers and emergency managers was about sheltering students and the general public. Some participants stated their procedures are the same as a lockdown procedure. One school decision maker table had the following discussion about letting people who show up at the door shelter at the school while they were playing the role of school decision makers.

> "I think procedure is its lockdown."
>
> "I understand its lockdown but…"
>
> "They can't get in."
>
> "And if you're sheltered."
>
> "That's something that we…"

"Parents driving up, stacked up out there."

"I'm in the shelter I am not going to know, they can stack up out there."

"You gonna let them in?"

"I'm not going to know they are there, so no."

"They need shelter too."

"I let about 75 in the other night they were cold."

"If you are locking up and someone is out there then of course let them in, but if you are in your tornado shelter and the building is locked down, you are not going to know they are out there."

"Well if its lockdown procedure"

A little later in the conversation,

"This is a human, I have procedures but…"

"This is a common sense thing…"

"I'm letting them in to seek shelter."

Decisions. There were many different discussions about when decisions should be made. Participants discussed making decisions too early in case the scenario does not pan out and also not wanting to wait too long to have adequate time to get everyone to safety. "It's supposed to be hitting early afternoon, this storm, so we don't want to wait too long to start taking action in my point of view" was a statement from one of the

school decision makers during the activity they were playing the role of school decision making. Another school decision making group had the following discussion during the same activity,

"I don't think we need to cancel activities yet."

"Would you send your daughter on that trip?"

"No."

"No."

"No."

"That's the thing, that answers the thing with other kids then."

"So we are cancelling after school activities."

During the same activity, another school decision maker group stated,

"Well how many days do we have that we have tornadoes likely and we don't have any?"

"Well yeah."

"A lot."

"So we can't cancel activities at this point yet."

Amongst all the groups, there was a lot of discussion about whether or not they should send students home early. Some of the reasons behind sending students home were due to the forecast, or looking at radar, and figuring out how much time they had

before the storm hit. A few of the participants brought up what happens when students are sent home early if their parents are not home, especially elementary students. One school decision maker asserted the following while playing the role of school decision maker, “You can’t win, you cannot win. If you cancel school, you can’t win.”

Confusion. There were many points in which the participants were either confused about information they were receiving or confused about their duties. Most of the confusion occurred during Activity A when they were playing the role of the other stakeholder. The schools were mostly confused about what the duties of the emergency manager were, what information and people were available to them, and how to understand the information the emergency mangers were given. One piece of information emergency managers read during a severe weather event is the mesoscale discussion that is issued by the Storm Prediction Center. During the activity, one school decision maker stated “I haven’t even looked at this mesoscale deal. Anyone know how to read this? Do you know how to read it?” Another statement from a different school decision making group was “Maybe, I don’t know how to read this map.” Two school decision making participants did not know that emergency managers had spotters (trained on the road storm chasers) available to them.

> “They have spotters?”
>
> “I don’t know how many spotters to know whether or how they communicate, you know what I mean? Do they communicate by e-mail or cell phone call?”

One of the duties of the emergency manager is to sound the outdoor warning system (siren) for the city or county they are responsible for. While schools were

playing the role of emergency manager, they did not realize it was their duty to sound the siren. When given the time stamp card that read, "You hear your NOAA Weather Radio go off saying there is a tornado warning issued for your area" one school decision making group had the following discussion,

"Are the sirens going off at this point?"

"It doesn't say..."

In addition to not knowing it was their responsibility to sound the siren, they also were confused about when the siren is issued. The following is a conversation at table of school decision makers acting as emergency managers after their time stamp card read there was a tornado warning issued.

"The TV will say it's a warning."

"I think the siren…"

"The warning has gone off."

"Well the tornado actually hasn't been sighted we are just…"

"Are we going to press the siren?"

"Yes."

"Well we have to right?"

"My watchers seen any tornadoes?"

[Arguing]

"We are looking at the radar, its spinning, and then you hear the monitor going off, spotters are saying…"

"I don't know either."

"It doesn't show a tornado on the ground."

"Prepare to sound the alarm."

"Yeah."

"Yeah Prepare."

Information Needs. There were a couple different types of information needs brought up during the discussion; including timeline of expected weather, severity and threat area of expected weather, confirmation of occurring weather from television meteorologist, and damage information. The most common was a timeline of when severe weather was expected along with the severity and probability. While playing the role of school decision makers, one school decision maker mentioned, "What time is it going to be here, does it have a timeline?" another school decision maker stated "I want to know how far out it is, it's travel, it's movement, estimated time of arrival." The other type of information they wanted was damage information or confirmation from a television meteorologist. While playing the role of school decision making, one school decision maker stated "I want (local newscaster) to come on the air and…" another said, "Where's (another local newscaster) when you need him?"

Learning. During the activity, participants noted that they were learning things by their participation. For example, when playing the role of an emergency manager,

one of the school participants explained, “Well, what I am learning from this is there is a whole lot about the emergency management system, how they operate, and what information they have access to and what they have to do…” Another school table, during Activity B, received an e-mail from their emergency manager and observed that “When we were emergency managers, we never sent e-mails to our schools.” This indicated they learned more about what emergency managers do during severe weather.

Toward the end of Activity C, one table began taking about what they had learned from situations throughout the workshop and began talking about the future. The following conversation was held by school decision makers while playing the role of school decision makers,

> “What would we do if we had, if we were hosting say a track meet ‘cause we get a lot of schools in here, what would we do with those students?”
>
> “Stick them in the gym I guess.”
>
> “Well I mean a real track meet. Norfolk High, what would we do with them?”
>
> “Stick them and put them inside you mean?”
>
> “Yea would we put them all inside, then how would we communicate with those school ‘cause those schools would want to know what is going on?”

Debrief Questions. After each activity, participants were asked three to five debrief questions. Four themes emerged from the transcription: challenges of other stakeholders’ professions, new knowledge, ease of making decisions, and future events.

Challenges of Other Stakeholders. After Activity A, Participants were asked what is hard about the other stakeholders' job. The most common response from schools playing the role of emergency managers was reading and understanding the information that emergency managers receive and look at during severe weather. For example one participant stated, "We couldn't understand how to read all the information. We were really unclear about how to read the maps and what was going on."

A general lack of understanding for what the emergency managers responsibilities are was another common response. One participant stated they assumed certain procedures would be in place prior to the event. For example, "We presumed that there was a procedure in place that who needed to be notified of what, and that somebody had to initiate that, but we hoped that, that was done ahead of time." This shows that they were noticing things that needed to be done and figured it was something that was done ahead of time and it was stated in the policy and procedures that emergency managers had. Information they felt was in the policies and procedures included who needed to be notified during severe weather, who sends out information, and when that information is sent out. However, in Oklahoma there is a not a set operations procedure.

New Knowledge. The responses for this theme were in response to the question: What do you know now, that before the activity you did not know? After Activity A, one participant offered, "Their job is really hard" when talking about emergency managers. Another participant agreed and added there was a lot that they didn't know about the other stakeholder and they receive a lot of information. One school participant

explained that it is important to find someone you trust because you need to have a filter with all the information that is available. Others added that they learned a lot by going through this activity and especially because of what happened in the recent past with a severe weather event, they also learned from those. One participant disclosed in reference to a past experience when their group cancelled activities, "I think if we would have had this back in January, this group here may not have cancelled those activities the day before…"

Ease of Making Decisions. After Activity A, the general consensus was that there were times that it was easy to make decisions based on the information they received, but there were many times it was difficult. They explained it was difficult because they didn't always have the information that they needed. One table realized that they thought they were ahead of the game in their decision making but afterward they realized they made those decisions too early. When asked this question after Activity B and they were back in their professional roles, the consensus was that it was easy to make a time call with the information they were given. However, each group cancelled after school activities at different times during the scenario. Again bringing up recent events, one table explained that it is not a cast in stone policy, but if there is a chance for severe weather and teams are not playing in a state tournament, they are going the cancel those activities. This was also the case for Activity C. Some groups cancelled after school activities the night before and some of the groups waited until later on the day of the severe weather event.

Future Events. Participants were asked if by going through this activity, it would change how they interact with other stakeholders in the future. The overall

consensus was “Yes.” One school participant stated, “I think one thing that has been important for us for several years is that we have worked hard to build relationships…” The emergency manager that participated showed the impact of the PBL experience when he shared, “Well yeah, I plan to get a little closer to schools instead of just taking a plan and putting it on a shelf.” Other responses included, that because they have gone through this activity, they have realized gaps in their own plans. One participant stated, “In our school, there needs to be communication upgrades”.

Pre/Post Questionnaire. The participants filled out a questionnaire before we began the workshop for the day and after the last activity was completed. The following section reflects the common categories and most common responses that were found amongst the participants’ questionnaires. As seen in in Tables 15 and 16, each question yielded a different number of categories. Each category was created based on commonalities of participants’ responses. There were 15 participants who completed the pre questionnaire and 13 participants who completed the post questionnaire. The first half of the questionnaire contained questions that pertained to the participant’s own professional roles. Participants for example, were asked, “What type of information is readily available to you during a severe weather event?” The second half of the questionnaire contained the same questions but was rephrased to ask about other stakeholders. For example the question would read, “What types of information is available to the other decision makers during a severe weather event?”

Table 15

Pre/Post Questionnaire Pertaining to Their Profession

Question	Category	Pre (n=15)	Post (n=13)
		% Responded	% Responded
What type of information is readily available to you during a severe weather event?			
	Phone	40	46
	Internet	47	62
	Radar	13	23
	NOAA Weather Radio	47	62
	Television	67	54
What types of information do you need during a severe weather event?			
	Location of Storm	53	54
	Severity of Storm	47	38
	Updates	0	31
What are your concerns on a severe weather day?			
	Safety of Students and Staff	80	69
What kinds of tasks must you do on a severe weather day?			
	Monitor Weather	33	38
	Preparedness	47	54
What kinds of distractions are present for someone in your role during severe weather event?			
	Students & Personnel	33	46
	Parents & Public	40	69

Table 16

Pre/Post Questionnaire Pertaining to Other Stakeholders

Question	Theme	Pre (n=15)	Post (n=13)
		% Responded	% Responded
What type of information is readily available to other decision makers during a severe weather event?			
	Didn't Answer/Confused	53	8
	Phone	20	0
	Television	20	46
	Weather Information	0	46
	Location of emergency manager 'stuff'	0	23
What are the types of information the other decision makers need during a hazardous weather day?			
	Didn't Answer/Confused	87	31
	Storm Information	0	38
What are other decision makers' concerns on a severe weather day?			
	Didn't Answer/Confused	80	54
	Emergency manager activities	13	31
What kinds of tasks must other decision makers do on a severe weather day?			
	Didn't Answer/Confused	67	46
What kinds of distractions are present for the other decision makers during severe weather event?			
	Didn't Answer/Confused	60	46

Chapter 7: Discussion, Implications, and Limitations

The purpose of this study was to identify school decision maker's informational needs as it pertains to hazardous weather, investigate whether stakeholders of the weather decision making process understand complexities, concerns, and information needs of other stakeholders, and to test if PBL is an effective way to train school decision makers to make hazardous weather decision proactively. There is information that informs these questions from all phases of the study: phase one (statewide survey), phase two (focus group), and phase three (PBL activity).

Discussion

RQ 1: What are the informational needs most crucial for school decision makers to have in order to make proactive decisions during severe hazardous weather?

Each phase of the current study provided insight for specific information that is needed for school decision makers to make decisions during hazardous weather. From phase one it was found that 80% of schools and 96% of districts do have multiple ways of receiving critical information for making decisions. While discussing this topic during phase two, participants stated that it is not only important to have information, but it is also important to find a source of information that you trust and is reliable. "Finding a source that you trust and a way to get that reliably is the key" is an example. This allows for confidence and proactive decision making which was another important issue stated from the focus group of phase two. When talking about being proactive, one participant explained, "I may e-mail the band director or even the athletic director and say you know if you have somebody going north today you might want to pay attention

to what is going on." Even with a lot of ways to receive critical information, phase one shows that 85% of schools and districts say they feel confident understanding a weather watch and warning map and 78% of schools and 93% of districts are comfortable using radar when making severe weather decisions. This shows that they do in fact have general weather knowledge. Also if you look at their levels of concern during the PBL activities, they were showing appropriate levels of concerns and were struggling to understand data given to them. They are invested in making good weather decisions and relied on their peers to try and understand the information given to them. Common comments during the PBL activity were things like "Anyone know how to read this?"

As for specifics about what types of information is most crucial, participants are concerned about the storms location and how fast the storm is moving. "What time is it going to be here, does it have a timeline?" is one example from the recordings of phase three. Another example from phase two was an emergency manager stating what kinds of information is important for him to provide his schools, "I am going to talk about the impact on that storm in our jurisdiction and what we think we ought to do, whether we are going to close schools or not close schools." This says that it is not only important for schools to receive storm timelines and storm severity, but also the impacts and the decisions that go along with that weather information are important as well.

Results within this section are consistent with what is found in the literature. Participants were not only concerned with what types of information they need to receive, but also that information is reliable so they can personalize and confirm it is correct for them to be able to respond to it (Mileti & Sorensen, 1990; Schumacher et al., 2010; Sorensen, 2000). The results from this research question also expand the literature

because this study shows that school decision makers do try and understand weather information that is given to them and it has provided insight to what types of information is needed for them to make decisions in relation to severe thunderstorms and tornadoes specifically.

RQ 2: How can you design instruction and effective learning activities based on documented information needs?

By using a systematic approach, I was able to use the results from the data collected to address research question one into the design of the problem based learning activity. By using these responses from the survey and focus group, which indicated what information is most crucial for school decision makers to use to make proactive decisions during severe weather, enhanced the problem based learning activity. For example, principals and superintendents talked about how busy their schedule was so having a busy schedule was an important part of the school personnel's role. Many of the survey participants talked about using the NOAA Weather Radio, so it was incorporated into the scenarios for phase three in several places to make it more relevant and realistic to participants.

RQ 3: Do stakeholders of the weather decision making process understand the complexities, concerns, and information needs of the other stakeholders in the communication chain?

During phase two participants discussed three different scenarios. Participants discussed what their responsibilities were on a severe weather day as well as discussed what informational needs they felt were most crucial for them to make decisions. In

addition, during phase three participants were asked specific questions about other stakeholder's concern, complexities, and distractions on the pre and post questionnaires. Participants also mentioned during their discussions concerns and complexities of other stakeholders during the activity in which they switched professional roles. From phases 2 and 3 between school decision makers and emergency managers there were many of these concerns stated amongst each stakeholder. This can be seen in the comments from schools in phase two and phase three. Numerous times schools maintained their main concerns are the safety of their students, "You want to be on the safe side rather than have some issues" is an example from phase two. Some of their other concerns are the general public coming to shelter, "here comes the people and their dogs", trying to decide against policy to let parents in to shelter because policy says lockdown procedure, parents calling asking about activities when they heard something on the television, when to run busses or not run busses, and finally the ease of receiving e-mails "We are not necessarily sitting at our terminals so that we can read e-mail."

Emergency managers have different concerns, complexities and distractions during severe weather. One emergency manager stated during phase two that it was his job "… to dissect how that statement with that coverage applies locally." Emergency managers are in charge of setting the sirens off, communicating with spotters, and even dealing with the general public calling in with reports and/or questions in regards to the weather. When schools played the roles of emergency managers, during phase three Activity A, they gained insight into the concerns, complexities and distractions of the people whose role was different than them during a storm. During the debrief questions one school participant stated, "We couldn't understand how to read all the information.

We were really unclear about how to read the maps and what was going on." Some participants also did not understand when they should sound the siren, or even that it was their responsibility "Are the sirens going off at this point?" is an example of a statement from the schools playing the role of emergency manager after they were told the NOAA Weather Radio set its warning tone off. In addition, there was one table that did not know emergency managers had spotters, or how they communicated with them. One participant explained their confusion, "I don't know how many spotters to know whether or how they communicate, you know what I mean? Do they communicate by e-mail or cell phone call?" This is interesting and important because it shows that the participant doesn't know what types of information emergency managers receive as well as who they receive it from. In addition it shows that participants didn't realize it was the emergency manager's job to coordinate where spotters go. Now knowing that it is not common knowledge that emergency managers have spotters to gather ground truth information from we know this is one piece of information that is important for schools to have an understanding about. From phase two, participants stated they wanted someone to call for information. However, if the emergency manager is giving them information and the school does not know where that information is coming from, they can't be sure it is reliable information.

The debrief questions and pre and post questionnaire show that participants now better understand these concerns and complexities. In response to the debrief question about what they know now about the other role that before the PBL activity they did not know, one participant shared, "There is a lot that we don't know about the other." Another participant had mentioned, "Their job is really hard." This shows before the

PBL activity, they did not understand the concerns, complexities, and distractions of the emergency management profession.

The results from this section show consistency with the literature in the fact that the communication dissemination process is highly complex and each stakeholder's decision making process is complicated. Streichert et al. (2005) state that members of cross-disciplines within the emergency management system are not aware of the working styles, assets, strengths and limitations of their partnering disciplines. These results also extend the literature because prior to the PBL activity, school decision makers were not aware of the influences on emergency managers specifically during severe thunderstorms and tornadoes. This is important to note because literature says that one of the roles of emergency management is to mitigate to prevent or lessen the impact of disasters to their town, city or county (League et al., 2010; Petak, 1985; Waugh & Streib 2006). Therefore, their understanding of the competing responsibilities that emergency managers face is important for school officials to support them in EM's in their roles.

RQ 4: Is PBL an effective way to train school decision makers to make these hazardous weather related decisions proactively, if so in what ways is PBL effective?

There were multiple categories that demonstrated by participating in this PBL activity, they were able to learn from their past experiences, think critically about an ill-defined problem, learn from one another, and think about future events because of this activity. These categories were shown from all three phases amongst the survey,

discussions from the focus group, discussions from the PBL activity, and the pre and post questionnaire.

Phases one and two both show that people bring their past experiences into their current decision making process. During phase one, a survey participant wrote, "As a result, we have developed a more comprehensive weather plan, but it still has not been fully communicated to all staff and students." From phase two, one participant remembered in reference to the May 3rd, 1999 tornado that hit Moore, Oklahoma, that a couple of the schools were able to have safe rooms built because they received money from FEMA. Since then their emergency manager "has been out to several buildings to declare where wind tunnels might be…" Another participant from phase two brought up an experience that did not affect him directly, but it was an event that affected schools. He stated, "In Alabama…when they had the tornado during the school day and they have had those kids in the building…" This shows that it is not only past experiences that happen directly to someone that will affect how they make decisions but also past experiences that are seen from the outside as well.

During the PBL activity, one participant used their past experiences of when severe weather occurs to state that having a tornado in February, was out of the norm in his own knowledge. This participant exclaimed, "It's February, there can't be tornadoes…" Another participant used their past experience to decide when they should cancel activities. In recalling a recent event in trying to remember when their superintendent cancelled activities, they remembered, "I think it was before lunch…" In addition one participant mentioned that if this activity would had been conducted earlier in the year, they would acted differently and probably not cancelled after school

activities as early as they did in the PBL activity. They realized they would have acted differently now because of a recent EF-5 tornado event that affected a nearby school district.

Going through the PBL activity allowed participants to think critically about an ill-defined problem in a controlled environment. Participants not only were able to think critically on their own, but they challenged each other as well. This was shown in the results section when they were discussing whether to cancel activities and someone asked if they would send their daughter. After thinking about the situation and how they would apply it personally, they decided they would cancel activities because they felt it would not be safe for their daughter. The participants were fully engaged in the PBL activity and willing to make it "real" and relate it to their lives.

Going through the PBL activity also allowed participants to learn from one another. "Well, what I am learning from this is there is a whole lot about the emergency management system, how they operate, and what information they have access to and what they have to do…" Another participant shared that by going through this activity, it showed that the emergency manager's job is really hard. In addition to learning about what other stakeholders do, because of this activity, they learned what information was available to them. From the pre/post questionnaire, there was an increase from 0% to 46% of school participants saying emergency manages have weather information available to them during hazardous weather. In addition, after going through this activity, the post questionnaire shows that more school personnel will monitor weather.

Lastly, by going through the PBL activity, participants started to think about what they would do during future events. One participant asked the others at their table what they would do if there was a track meet at their location and they had to shelter all of the teams and parents that were visiting. The activity also changed how participants would interact with other stakeholders. This was shown in the debrief responses where participants said they plan to do more than just put the plan on the shelf.

Results from this section are consistent with the PBL literature that states PBL can be effective in training decision makers to solve ill-structured problems, scenarios used in PBL should be authentic and motivating so participants are engaged (Jonassen & hung, 2008; Savery, 2006), and used to train for dangerous situations (Halm, Lee, & Franke, 2010; Streichert et al., 2005). This study adds to the literature by introducing new contexts that PBL can be used to train for (e.g. severe thunderstorms and tornadoes) as well as additional stakeholders (school decision makers and emergency management) that can benefit from using PBL as a learning strategy.

Implications

The results from this study offer suggestions for the future professionals in the use of and design of PBL activities. In designing the study, a statewide sample was used as the initial needs assessment. Their responses showing a need for information and training established an instructional need and a population that would benefit from training. From the initial needs assessment conducted, even though a problem was shown, the specifics components of the problem were not clear.. From there, the local focus group of phase two was conducted. This allowed the specific characteristics of the problem to become clear. From the information gathered from the statewide sample of

data and the information and characteristics of the focus group, the PBL activity was able to be designed specifically for the stakeholders involved and the problem indicated. This two prong approach was effective and helped to create a robust activity that could be used with any region throughout the state.

The evaluation of the PBL activity showed that participants learned new information, and were engaged throughout the entire activity. This evidence shows that using an instructional design process provided worthwhile scaffolding for designing a PBL activity for these specific stakeholders. Using a combination of a statewide survey, focus groups, and the PBL activity to collect data, allowed for triangulation of the results but also provides generalizability to a larger audience (Creswell, 2012b).

Implications for future design

Part of the Morrison's et al (2011) instructional design model is constant review and revision. For future administrations of this activity there would be several changes made. First it is possible the participants did not have enough time to write their answers on the time stamp cards. For example, one table wrote "Weather Information" in response to what types of information they needed and wanted. However, in the recordings the participants listed out some of the types of specific weather information they wanted (e.g. storm severity). This indicated participants either need more time to write answers on the back of their time stamp cards, or have options to choose from based on the results from the current study. Even though the current average lead time is 11 minutes (Simmons & Sutter, 2008) which replicates the short time school decision makers have to make decisions, for the purposes of learning, participants may need more time. This would be one of the areas that would need to be tested in the future.

Next, it is questioned whether participants were able to complete Activity B without using their knowledge of knowing what happens during the designed event. To address this concern in the future, instead of using the same case twice, future administrations will use three separate cases. This ensures that the participants are not using what they know already happens from seeing the case all the way through previously. In addition to substituting the second case so it is not the same as the first, it would be beneficial to use a case that does not end with a tornado occurring. This would challenge the participants to think about repercussions (e.g. cancelling activities) of their actions instead of cancelling activities early because of an impending event. There are many times where tornado warnings occur and a tornado does not happen so this would illustrate real life situations as well.

By making and testing these simple revisions to the design of the PBL activity, it will aid in the development of a sustainable training program to help school decision makers making hazardous weather decisions proactively. Given the time stamps and linear nature of the activity, there is also a possibility of taking the activity online to allow greater dissemination to a larger national audience.

Limitations

There were several limitations within the current study. The first limitation was a recent severe weather event that affected one of the school districts that was supposed to attend the PBL workshop. This not only affected to sample size but it was also an event that affected many of the participants personally. Because of this personal connection, it is not clear if participants chose their actions because of procedure in their schools or from reaction of the recent event. In addition, more than once a

participant stated that if this workshop would have been administered before the severe weather event, their decisions and actions would have been different. However, since personal experiences are an important part of PBL, this was authentic but it may have limited some of the generalizability of the results. In addition to the school district not in attendance, the local emergency managers that served all the districts present were not able to attend. Even though there was an emergency manager present, by not having the emergency managers for the areas of the schools who participated, it did not allow the school districts to have the interaction they typically would have had. For Activity C, the emergency manager worked alone and was not able to benefit from the collaborative nature of PBL.

Another limitation is it is possible the participants did not have enough time to write their answers on the time stamp cards. For example, one table wrote "Weather Information" in response to what types of information they needed and wanted. However, in the recordings the participants listed out some of the types of specific weather information they wanted (e.g. storm severity). This indicated participants either need more time to write answers on the back of their time stamp cards, or have options to choose from based on the results from the current study. Additionally since the groups did not answer what they were confused about for the confusion question, they should be given choices or more opportunity to provide detail. This may help to also expose information needs and weather misconceptions within the participants.

Finally, because there were tornado misconceptions that were stated throughout the activity (e.g. tornadoes do not happen at night, and there is not a tornado without a siren) it would be beneficial to have an instructional portion after the activities

conclude. This allows the facilitator to address weather misconceptions so participants are not leaving the activity with the incorrect information to drive decisions during an actual event. The goal with this PBL activity is to have the participants think critically and use their past experiences to solve an ill-defined problem in a controlled environment in order to make hazardous weather decisions proactively. If decisions are being made based on severe weather misconceptions then, in hindsight, it could be causing more harm than good.

Conclusion

The results of this study are consistent with and extend the literature in several ways. The areas in which it supports existing research includes: issues with communication stream, complexity of decision making for school personnel and emergency managers, and the use of PBL to train decision makers for dangerous situations. There were also areas that expanded the literature including the misconceptions present by participants and the value of PBL as a method to train school personnel to make proactive weather decisions. Since there have not been studies that use PBL in the context of training school decision makers to make severe hazardous weather, this study presents a new area in which PBL can be applied.

In the past five years there have been 64 fatalities in the state of Oklahoma with 33 thus far in 2013 (Storm Prediction Center, 2013b). Seven of those 33 died within a school from the May 20th, 2013 Moore, OK tornado (National Weather Service, 2013c). It has been shown that proactive severe weather decision making is important because some decision makers do not receive warning information directly, but rather are waiting on others to communicate it to them (Schumacher et al., 2010). This was shown

to be the case from an elementary school building survey participant "The weather radio went off just before the emergency manager called the superintendent, who called the elementary, as the town sirens were going off." This shows consistency with research about the complexity of the decision making process. Research shows that the process for a person to make a protective weather decisions are as follows: a person must receive hazardous weather information, understand the weather information, believe the weather information, personalize the weather information, confirm that the information is correct, and finally respond to the hazardous weather information before the action actually takes place (Mileti & Sorensen, 1990; Schumacher et al., 2010; Sorensen, 2000). This is consistent with a response from one participant of the focus group when discussing watching the different television stations. The participant explained it was confusing because each station was saying something different. This study shows there are many different stakeholders that can be a part of the decision making process with television personalities as one of them. Participants stated that parents also call in asking questions about after school activities, and students come to school with knowledge of it being a severe weather day. This brings additional information to the school decision makers adding to the confusion they are hearing from the television stations. This finding is consistent with Schumacher et al's., (2010) finding that anecdotal information is a way that information is receive and it can introduce false information and contradicting stories.

The complexity of the decision making process can introduce a delay in the communication process. Because of this, being prepared for severe weather is extremely important. One piece of equipment that allows school to receive information directly

from the National Weather Service, therefore decreasing the communication delay is the NOAA Weather Radio. The NOAA Weather Radio sounds an alert tone when both a watch and warning are issued by the National Weather Service. It was shown that 47% of schools and 38% of districts stated they do not have a NOAA Weather Radio or they do not know if they have one. It was also shown that 50% of schools and 80% of districts rely on the NOAA Weather Radio to make critical weather decisions. This is alarming because this says that the majority of schools and districts are relying on this piece of equipment to make critical weather decisions but just under half of schools and districts do not know if, or are unsure, if they have a NOAA Weather Radio. How can schools and districts make decisions based on the NOAA Weather Radio if they do not have one? In addition to using the radio, the majority of schools and districts also rely on the sirens when making critical decisions. Sirens are only sounded when the emergency manager chooses. This is typically when a tornado warning is issued. This is concerning because currently the average tornado lead time is 11 minutes (Simmons & Sutter, 2008). This says there is about 11 minutes from the time the warning is heard to get everyone to safety. This is a concern when you think to whom a school leader must communicate (e.g. coaches on sports fields, each individual school site etc..). Waiting until the siren is heard may not be enough time to get everyone to safety.

It was shown that one of the stakeholders amongst the decision making process is the emergency manager. Currently there is weather training (OK-First) available to emergency managers in Oklahoma. OK-First is not officially available to school personnel however, school personnel are becoming more interested and few have participated in recent years. This shows school decision makers are looking to be

trained. PBL as shown in the Streichert et al. (2005) and their cross-discipline training in emergency preparedness and as its defined, was the right instructional strategy to use for training school decisions makers to make proactive decisions in relation to severe weather because of its dangerous nature. Since PBL is a learner-centered approach that allows participants to apply knowledge and skill within a small group setting to develop a viable solution to a problem (Jonassen & Hung, 2008; Remedios, Clarke, & Hawthorne, 2008; Savery, 2006). The principles used in PBL are that problems must be open ended, ill-structured (Jonassen & Hung, 2008; Savery, 2006), complex so as to motivate and engage participants and their interest, authentic, and encourage the use of prior subject matter knowledge (Jonassen & Hung, 2008). Over 65% of school building personnel and over 80% of districts stated they would feel confident in making a severe weather decision if it was left to them. This indicates they were suitable for a PBL activity because they felt they had knowledge in the subject matter. This study demonstrated that PBL effectively engaged the participants in exploring their weather related decisions, their relationships to other stakeholders, and the responsibilities of other stakeholders in the weather decision process. Participants were clearly engaged as shown by laughter, sharing of stories of past experiences, and their struggle to understand the information presented to them. This study also showed that participants did apply their past experiences to their decision making by telling stories to their other team members, which allowed other participants to learn from one another.

This study showed that participants do have a general knowledge about weather. This was demonstrated when asked what actions they would take, and their responses included, “Monitor weather.” However, there were also severe weather misconceptions

mentioned throughout the PBL activity. This indicates a need for PBL to be paired with some type of instruction. By pairing PBL and lecture instruction it allows the facilitator to address misconceptions so participants are not using them as reasons behind actions during a real event. In addition to misconceptions heard, there were also informational needs stated by the participants of the PBL activity. The most common information request was severity and timeline of the storm (e.g "What time is it going to be here, does it have a timeline?")

The PBL activity also showed that participants were able to gain an understanding of the complexities, concerns, and informational needs of other stakeholders. This was shown in the post questionnaire where there was a response increase of 46% of participants stating other stakeholders have weather information available to them. In addition one participant had stated they learned a lot about the emergency management system and how they operate. Other responses included "Their job is really hard."

Lastly, prior to the PBL activity, this study showed that 24% of districts do not know, or they are unsure, if their emergency manager communicates with the district office during severe weather and after the activity, school participants stated that in the future they plan to increase their communication with their emergency manager during these severe weather events. In addition, 32% of school building personnel stated that the district office does not, or they are unsure, communicate with school buildings during hazardous weather. Putting this into perspective, that means that 682 schools out of over 2,200 in the state of Oklahoma are not being communicated with from their district offices during hazardous weather. After the PBL activity, it was stated

participants would start communicating more to one another. For example, the emergency manager stated “I plan to get a little closer to schools”.

In conclusion PBL is an effective way to train school decision makers to make hazardous weather decisions proactively. Originally, before the PBL activity, participants did not know the extent of concerns, complexities, and distractions of other stakeholders, but after they gained this understanding. The participants learned from the PBL activity and they plan on making changes in the future. PBL is an effective instructional strategy for the task of training school decision makers to make proactive hazardous weather related decisions.

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Appendices

Appendix A: Survey Recruitment Script

School Personnel and Emergency Managers,

Hello, my name is Sarah Stalker I am currently a Masters of Education Psychology student at the University of Oklahoma working in collaboration with the Oklahoma Climatological Survey. The Oklahoma Climatological Survey and I would like to ask for your participation in a brief survey focused on hazardous weather and school decision making. This survey is being administered statewide and is intended for school personnel (teachers, principals, administrators, etc.) and emergency managers. The survey will only take about 10 minutes to complete.

You are also welcome to share this survey with any email lists you use or any colleagues you work with. The information collected in this survey is being used to evaluate the need for a new weather hazards outreach program for K-12 staff at schools across Oklahoma.

The survey can be accessed here:

http://www.surveymonkey.com/s/W8WRD6Z

Thank you so much for your time,

Sarah Louise Stalker

(405)-325-2541

sarah.stalker@ou.edu

The OU IRB has approved the content of this message but not the method of distribution. The OU IRB has no authority to approve distribution by mass e-mail.

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Appendix B: Survey Questions

About Me Section

If you would like to provide your contact information, please input it below.

Name: _____

E-mail:_____

Zip Code of My Workplace (for ensuring statewide participation in this survey):

Zip Code:

I work as a/an:

- Disrtict Superintendent
- District Assistant Superintendent
- District Director
- District-Level (other position)
- Emergency Manager
- Emergency Management (other position)
- School Counselor
- School Librarian
- School Office Staff (Secretary, Office Assistant, etc.)
- School Principal
- School Teacher
- School Teacher Assistant
- School-Level (other position)
- None Of These

About how long have you been in your current position?

- 0-5 Years
- 6-10 Years
- 11-15 Years
- >15 Years

I have had formal weather related training.

- Yes
- No

School Specific Section

Preparedness

Please indicate your level of agreement with each of the following statements.

Our designation shelter location in our school would keep us safe during a tornado.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I am confident in the duties I am responsible for when severe weather is present.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Our school has rehearsed tornado drills at different times of the day.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Our school has rehearsed tornado drills at the beginning and/or end of the school day.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I feel our school is well prepared and able to handle any hazardous weather situation that happens on a school day.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Our school has a NOAA Weather Radio.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Our school has a hazardous weather safety plan or policy.

- Yes
- No
- I don't know

[If they answer yes to this question, they will be asked the following question, if not, they will skip the following question.]

Please indicate your level of agreement with each of the following statements.

I know exactly for what hazardous weather events my school enacts the weather safety plan or policy.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I know who the individual(s) is/are responsible for activating the weather emergency plan or policy.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree

- Agree
- Strongly Agree

When the weather emergency plan or policy is activated, I feel confident in what I am supposed to do/how I am supposed to react.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Our school's weather emergency plan or policy accounts for a variety of scenarios, such as hazardous weather occurring before, during, and after school as well as during arrival and departure times.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

If a severe weather decision was left to me I would feel confident in my weather knowledge to make a decision for my school.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Weather Information

How much does your school rely on the following sources of information to make critical decisions during a severe hazardous weather event day when school is in session?

Local Weather Expert (i.e., parent who is a meteorologist, etc.)

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

National Weather Service – Phone

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

National Weather Service – Website

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

NOAA Weather Radio

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Outdoor Warning System (Sirens)

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Radio

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Television

- Do Not Rely On
- Somewhat Rely On
- Rely On

- Not Sure

Weather App on my Phone/Tablet

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Weather Company Website (Paid Subscription)

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Please indicate your level of agreement with each of the following statements.

Our school has multiple ways of receiving critical weather information.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Our school primarily uses one source of information when looking for information on hazardous weather. (If you agree, what is that source of information?)

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I feel confident about understanding a weather 'watch' map and knowing what it means.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I feel confident about understanding a weather ‘warning’ map and knowing what it means.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I feel confident about understanding and using radar to aid in a weather safety decision.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Communication

Please indicate your level of agreement with each of the following statements.

The emergency manager communicates with our school.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

The superintendent communicates with our school during hazardous weather.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

How are parents notified of weather-related school actions such as sheltering, campus evacuation, or a modified bus schedule?

- Automated Phone Call
- Automated Text Message
- E-mail
- Local Television
- Personal Phone Calls
- No Notifications are Sent
- I Do Not Know

How do bus drivers receive critical weather information (such as a tornado warning) while driving their routes?

- 2-Way Radio Communications
- 2-Way Radio Communications with GPS Location Capabilities
- Cell Phone Communications
- We Do Not Currently Have This Capability
- I Do Not Know

Past Experiences

Recall the last time hazardous weather has affected your school. Please provide your thoughts about the experience, how you felt your school was prepared, what types of information you received (or wish you received) along with who that information came from, and finally what you school has changed (if anything) because of that experience. [Open Ended Question]

District Level Section

Preparedness

Please indicate your level of agreement with each of the following statements.

The designated shelter location in the schools of my district would keep the students and staff safe during a tornado.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I am confident in the duties I am responsible for when severe weather present.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I am confident the principals of the school in my district know the duties they are responsible for when severe weather present.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I am confident the teachers of the schools in my district know the duties they are responsible for when severe weather is present.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

The schools in my district rehearse tornado drills at different times of the day.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

The schools in my district rehearse tornado drills at the beginning and/or end of the school day.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I feel the schools in my district are well prepared and able to handle any hazardous weather situation that happens on a school day.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Each school site, including the district office, has a NOAA Weather Radio.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

If a severe weather decision was left to me, I would feel confident in my weather knowledge to make a decision for my school.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Each school in my district has a hazardous weather safety plan.

- Yes
- No

- I don’t know

[If they answer yes to this question, they will be asked the following question, if not, they will skip the following question.]

Please indicate your level of agreement with each of the following statements.

I know exactly for what hazardous weather events my school enacts the weather safety plan.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I know who the individual(s) is/are responsible for activating weather emergency plan.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

When the weather emergency plan is activated for any of my schools, I feel confident with what I am supposed to do/how I am supposed to react.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

The weather emergency plan for the schools in my district accounts for a variety of scenarios, such as hazardous weather occurring before, during, and after school as well as during arrival and departure times.

- Strongly Disagree

- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Weather Information

How much do you rely on the following sources of information to make critical decisions during hazardous weather event day when school is in session?

Local Weather Expert (i.e., parent who is a meteorologist, etc.)

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

National Weather Service – Phone

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

National Weather Service – Website

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

NOAA Weather Radio

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Outdoor Warning System (Sirens)

- Do Not Rely On
- Somewhat Rely On
- Rely On

- Not Sure

Radio

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Television

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Weather App on my Phone/Tablet

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Weather Company Website (Paid Subscription)

- Do Not Rely On
- Somewhat Rely On
- Rely On
- Not Sure

Please indicate your level of agreement with each of the following statements.

The schools in my district have multiple ways of receiving critical weather information.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I have multiple ways of receiving critical weather information.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Our district primarily used one source of information when looking for information about hazardous weather. (If you agree, what is that source of information?).

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I feel confident about understanding a weather ‘watch’ map and knowing what it means.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I feel confident about understanding a weather ‘warning’ map and knowing what it means.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I feel confident about understanding and using radar to aid in a weather safety decision.

- Strongly Disagree
- Disagree

- Neither Disagree nor Agree
- Agree
- Strongly Agree

Communication

Please indicate your level of agreement with each of the following statements.

The emergency manager communicates with the schools in our district when there is hazardous weather.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

The emergency manager communicates with the district office when there is hazardous weather.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

The district office communicates with the schools in the district during hazardous weather.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

How are parents notified of weather-related school actions such as sheltering, campus evacuation, or a modified bus schedule?

- Automated Phone Call
- Automated Text Message
- E-mail

- Local Television
- Personal Phone Calls
- No Notifications are Sent
- I Do Not Know

How do bus drivers receive critical weather information (such as a tornado warning) while driving their routes?

- 2-Way Radio Communications
- 2-Way Radio Communications with GPS Location Capabilities
- Cell Phone Communications
- We Do Not Currently Have This Capability
- I Do Not Know

Past Experiences

Recall the last time hazardous weather has affected a school in your school district. Please provide your thoughts about the experience, how you felt you were prepared, what types of information you received (or wish you received) along with who that information came from, and finally what you or your school district has changed (if anything) because of that experience. [Open Ended Question]

Emergency Management Section

Preparedness

Please indicate your level of agreement with each of the following statements.

The designated shelters in the district I am responsible for would keep the students and staff safe during a tornado.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I am confident in the duties I am responsible for when severe weather is present.

- Strongly Disagree

- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I am confident the superintendent knows the duties they are responsible for when severe weather is present.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Schools in the district I am responsible for have rehearsed tornado drills at different times of the day.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Schools in the district I am responsible for have rehearsed tornado drills at the beginning and/or end of the school day.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I feel schools in the district I am responsible for are well prepared and able to handle any hazardous weather situation that happens on a school day.

- Strongly Disagree
- Disagree

- Neither Disagree nor Agree
- Agree
- Strongly Agree

The schools in the district that I am responsible for all have a NOAA Weather Radio.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

If a severe weather decision was left to the superintendent, I feel confident in their weather knowledge to make safety decisions for their schools.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

If a severe weather decision was left to the individual school sites, I feel confident in their weather knowledge to make safety decisions for their schools.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

The schools in the district I am responsible for have a weather safety plan or policy.

- Yes
- No
- I Do Not Know

[If they answer yes to this question, they will be asked the following question, if not, they will skip the following question.]

Please indicate your level of agreement with each of the following statements.

I know exactly for what hazardous weather events the schools enact their weather safety plan or policy.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I know who the individual(s) is/are responsible for activating weather emergency plan or policy.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

The school's weather emergency plan or policy accounts for a variety of scenarios such as hazardous weather occurring before, during, and after school as well as during arrival and departure times.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Communication

Do your job responsibilities require that you provide information and advisement to schools regarding hazardous weather situations (such as lightning approaching an athletic even, tornado storms approaching during the day, etc.)?

- Yes
- No
- I Don't Know
- Other (Please specify _____)

Please indicate your level of agreement with each of the following statements.

I interact with the schools in the district(s) I am responsible for during hazardous weather.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

I interact with the superintendent for the district(s) I am responsible for during hazardous weather.

- Strongly Disagree
- Disagree
- Neither Disagree nor Agree
- Agree
- Strongly Agree

Past Experiences

Recall the last time hazardous weather has affected a school in your jurisdiction. Please provide your thoughts about the experience, how you felt you and the school were prepared, what types of information you received (or wish you received) along with who that information came from, and finally what you and/or school has changed (if anything) because of that experience. [Open Ended Question]

Appendix C: Focus Group and PBL Activity Consent Form

University of Oklahoma

Institutional Review Board

Informed Consent to Participate in a Research Study

Project Title: Weather Decision Making

Principal Investigator: Sarah Stalker

Department: Education Psychology

You are being asked to volunteer for this research study. This study is being conducted at The University of Oklahoma. You were selected as a possible participant because you had given your contact information during the online survey you participated in.

Please read this form and ask any questions that you may have before agreeing to take part in this study.

Purpose of the Research Study

The purpose of this study is to evaluate the need for a new outreach program involving weather preparedness for schools on hazardous weather days.

Number of Participants

About 1000 people will take part in this study.

Procedures

If you agree to be in this study, you will be asked to openly discuss items from the online survey with other individuals in the focus group who have also participated in the online survey.

Length of Participation

Participation in the focus group will take about 3 hours for each focus group you attend. If you do not wish to stay the entire focus group, you are not required.

Risks of being in the study are

There are no risks from being in this study.

Benefits of being in the study are

There are no benefits from being in this study.

Compensation

You will not be reimbursed for you time and participation in this study.

Confidentiality

In published reports, there will be no information included that will make it possible to identify you. Research records will be stored securely and only approved researchers will have access to the records.

There are organizations that may inspect and/or copy your research records for quality assurance and data analysis. These organizations include only the OU Institutional Review Board.

Voluntary Nature of the Study

Participation in this study is voluntary. If you withdraw or decline participation, you will not be penalized or lose benefits or services unrelated to the study. If you decide to participate, you may decline to answer any question and may choose to withdraw at any time.

Waivers of Elements of Confidentiality

Your name will not be linked with your responses unless you specifically agree to be identified. Please select one of the following options

_____ I consent to being quoted directly.

_____ I do not consent to being quoted directly.

_____ I consent to having my name reported with quoted material.

_____ I do not consent to having my name reported with quoted material

Audio Recording of Study Activities

To assist with accurate recording of your responses, focus groups may be recorded on an audio recording device. You have the right to refuse to allow such recording without penalty. Please select one of the following options.

I consent to audio recording. ___ Yes ___ No.

Contacts and Questions

If you have concerns or complaints about the research, the researcher(s) conducting this study can be contacted at

Sarah Stalker	Dr. Theresa Cullen	Kevin Kloesel
(405)-325-2541	(405)-325-3755	(405)-325-2541
sarah.stalker@ou.edu	tacullen@ou.edu	longhorn@ou.edu

Contact the researcher(s) if you have questions or if you have experienced a research-related injury.

If you have any questions about your rights as a research participant, concerns, or complaints about the research and wish to talk to someone other than individuals on the research team or if you cannot reach the research team, you may contact the University of Oklahoma – Norman Campus Institutional Review Board (OU-NC IRB) at 405-325-8110 or irb@ou.edu.

You will be given a copy of this information to keep for your records. If you are not given a copy of this consent form, please request one.

Statement of Consent

I have read the above information. I have asked questions and have received satisfactory answers. I consent to participate in the study.

Participant Signature Print Name Date

Signature of Person Obtaining Consent Date

Print Name of Person Obtaining Consent

Appendix D: PBL Activities A & B, Henryville Indiana Materials

Emergency Manager Guidelines

At each time stamp on the back of the card, answer the following questions:

1. What actions do you take?
2. Why do you choose to take those actions?
3. On a scale from 1-10, how concerned are you? (1= Not concerned at all and 10=Completely concerned)
4. What information do you want and need at this point?
5. On a scale from 1-10 how confused are you? (1= Not confused 10= Completely confused) What is confusing you?

Guidelines:

You are allowed to use radar throughout this exercise. However, you are only allowed to play the video that corresponds to the time on your most recent time stamp card.

If you decide an action is to e-mail or call someone, please draft what you would say on a blank sheet of paper provided.

Radar Tips:

Counties that are colored in yellow = Tornado Watch issued for those counties.

Orange boxes around storms = Severe Thunderstorm Warning

Red boxes are storms = Tornado Warning

Emergency Manager Time Stamp Cards	
Wednesday February 29th, 6:00 PM You are watching your favorite news station and hear the following: "We are expecting some severe weather on March 2nd. We will keep you updated here on Channel 11. Visit our website for more and tune in at 11 tonight."	**Thursday March 1st, 8:00 AM** You have decide to keep an eye on the outlooks as they are issued throughout the day so you pull up the now Day 2 Outlook which was issued at 2:00 AM.
Thursday March 1st 12:30 PM You noticed a new Outlook for day 2 was issued at 12:30 PM.	**Thursday March 1st 9:00 PM** You decide to watch the news at 9:00 while you look at the Day 1 Outlook that was issued at 8:00 PM. You hear the following from the news station: "Tomorrow is going to be a big severe weather day, better make sure that storm shelter is cleaned out. We are expecting storms to happen in the early afternoon hours. Be sure to check with us, join us at 11 tonight for a special extended forecast."

Friday March 2nd, 8:00 AM You arrive at work in the morning and see the most recent Day 1 Outlook that was issued at 1:00 AM. You also notice 4 Mesoscale Discussions available	**Friday March 2nd, 11:30 AM** You get back to your office and you notice another Mesoscale Discussion and Outlook are available to look at.
Friday March 2nd, 1:05 PM You notice storms have started to show up west of the area you are responsible for (Radar is available). Additionally, another Mesoscale Discussion was issued at 1:05 PM. You also notice a tornado watch is issued from 1:05 PM - 9:00 PM.	**Friday March 2nd, 1:45 PM** You hear your NOAA Weather Radio go off saying there is a tornado warning issued for your area. (New radar is available)

Friday March 2nd, 2:10 PM You hear the television report there is a tornado on the ground. (New radar is available)	**Friday March 2nd, 2:30 PM** You hear the television report that the tornado has lifted and you see the helicopter's live footage of extensive damage. (New radar is available)
Emergency Manager Happenings Cards	
Oops, you fell asleep and missed the 11 o'clock news	**You receive a phone call from the police chief; he wants you to do a morning briefing about what the weather is going to be like for the day**

Your phone rings. Your significant other calls you at work because their coworker said the weather was supposed to start getting bad before the work day was done. They want to know what to do.	**You have to get spotters into position.**
Radar update available. You may move to 1:30 PM on radar.	**Cousin from down the street calls to ask if they should go to the basement.**

Spotter reports tornado on the ground.	**Farmer calls in saying part of his barn is gone.**
Law enforcement calling with numerous damage reports.	**You have lost cell phone service.**

You receive a call from a school district in your jurisdiction, wanting to know…	**You receive a call from a school district in your jurisdiction, wanting to know…**
You have received a call from the local hospital asking for a weather update.	**The nursing home in Henryville, IN has called asking if they need to move their patients into the hall way.**

Police chief wants a phone call when he should deploy local law enforcement.	

Information to Stakeholder Sheet

1. What is the date and time on your time stamp card? What Role are you playing?

   _____

2. How would you like to contact them? (circle one)
   a. E-mail
   b. Landline Phone
   c. Cell Phone
3. What Message would you tell them?

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

They also had access to the weather data from the time including;

Convective Outlooks, Mesoscale Discussions, and Tornado Watches

School Rules and Guidelines

At each time stamp (yellow card) on the back of the card, answer the following questions:

1. What actions do you take?
2. Why do you choose to take those actions?
3. On a scale from 1-10, how concerned are you? (1= Not concerned at all and 10=Completely concerned)
4. What information do you want and need at this point?
5. On a scale from 1-10 how confused are you? (1= Not confused 10= Completely confused) What is confusing you?

School Schedule

6:00 AM - 9:00 AM	Buses Enroute
9:00 AM - 4:00 PM	Classes in Session (Elementary, Middle School, High School)
2:00 PM	Buses Leave Elementary School
3:00 PM	Buses Leave Middle School
4:00 PM	Buses Leave High School
5:00 PM	Buses Return to Garage.

Activity Schedule

Time	Activity	Place
3:00 PM	Bus Leaves for Track Meet	Away (30 Miles)
6:00 AM – 9:00 PM	Tennis Tournament	Away (60 miles)
5:00 PM	JV Baseball Game	Home (High School)
8:00 PM	Varsity Baseball Game	Home (High School)
5:00 PM	JV Softball Game	Home (High School)
7:00 PM	Varsity Softball Game	Home (High School)
7:30 PM	Band Concert	High School

Guidelines:

You are allowed to use radar throughout this exercise. However, you are only allowed to play the video that corresponds to the time on your most recent time stamp card.

If you decide an action is to e-mail or call someone, please draft what you would say on a blank sheet of paper provided.

School Time Stamp Cards

Wednesday February 29th, 6:00 PM You are watching your favorite news station and hear the following: "We are expecting some severe weather on March 2nd. We will keep you updated here on Channel 11. Visit our website for more and tune in at 11 tonight."	**Thursday March 1st, 8:00 AM** You click to your favorite news website and see the following: "Big severe weather day tomorrow, make sure you have your preparedness plans in place and keep our page open we will keep you updated."
Thursday March 1st, 9:00 PM You decide to watch the news at 9:00 PM. You hear the following from the news station: "Tomorrow is going to be a big severe weather day, better make sure that storm shelter is cleaned out. We are expecting storms to happen in the early afternoon hours. Be sure to check back with us, join us at 11 tonight for a special extended forecast."	**Friday March 2nd, 8:00 AM** You show up at school for the morning and pull up your calendar on the computer. The following is your schedule for the day. Morning: 9:00 AM Meeting (Conference Room) 11:00 AM Meeting (Another Building) Afternoon: 1:00 PM Meeting (Conference Room) 2:00 PM Meeting (Conference Room) 3:00 PM Leave for Daughter's Track Meet

Friday March 2nd, 11:00 AM Meeting All the talk before the meeting is talking about storms and what time everyone heard they are going to begin. It sounds like everyone agrees that they heard storms should be in the area between 1 and 4 o'clock.	**Friday March 2nd, 12:30 PM** You have time to eat lunch quick at your desk and decide to pull up the news station website and check to weather. You see radar and some storms that are far off to your west.
Friday March 2nd, 1:05 PM You hear the alert from your weather application on your phone notifying you that your area is under a tornado watch until 9:00 PM tonight.	**Friday March 2nd, 1:45 PM** Someone tells you the NOAA Weather Radio just went off saying a tornado warning has been issued for your area. At the same time you hear the warning alert from the weather application on your phone.

Friday March 2nd, 2:09 PM You hear television report that there is a tornado on the ground.	**Friday March 2nd, 2:30 PM** You hear the television report that the tornado has lifted and you see the helicopter's live footage of extensive damage.

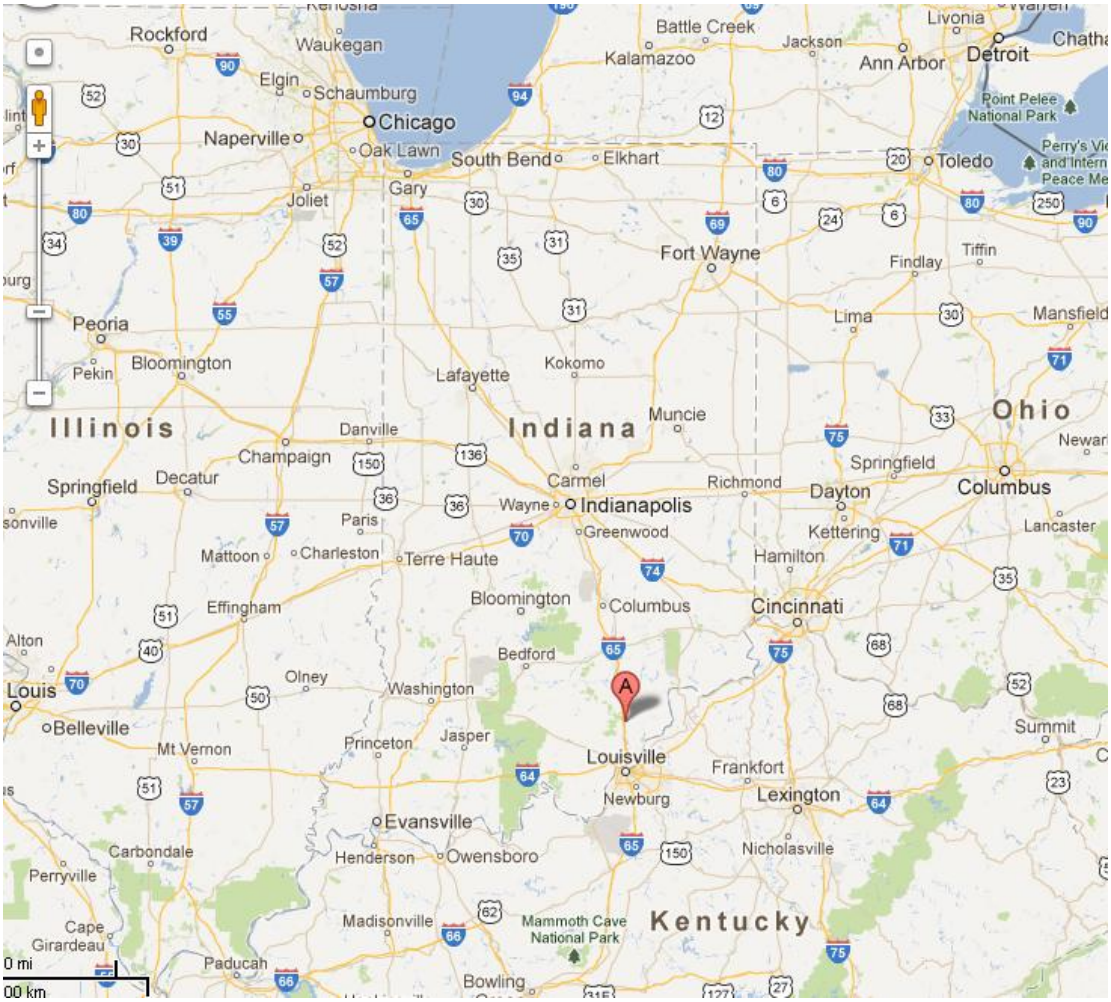
School Happenings Cards

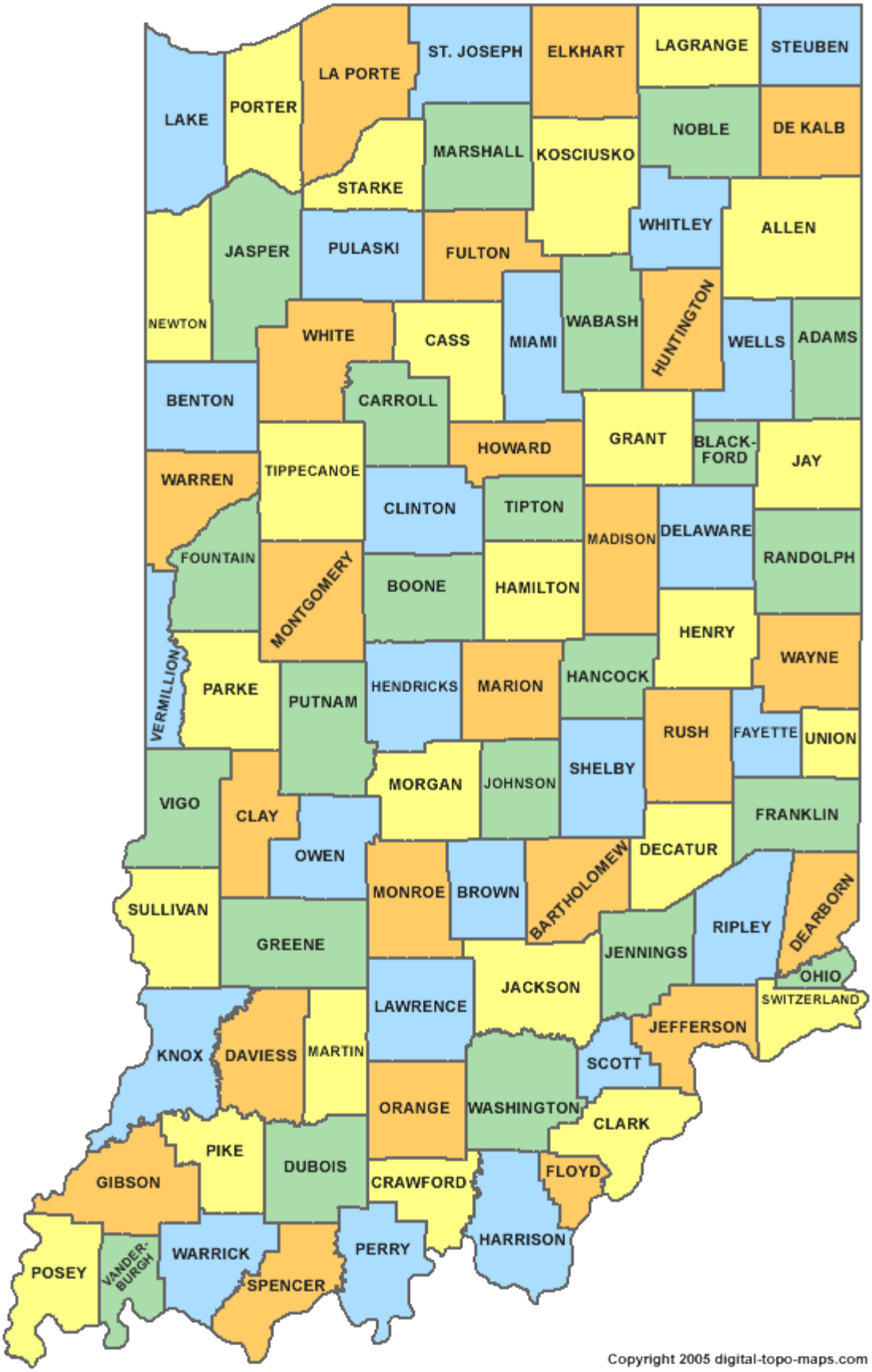
Oops, you fell asleep and missed the 11 o'clock extended forecast.	**You have turned on the TV and it is showing radar for all of the storms. It is only talking about the storms that are currently in Evansville.**

You can see lightning and hear thunder. Parents showing up to school to get their kids.	**You have your own kids located at a different school site.**
Parents calling asking about baseball games tonight.	**Different parents calling to see if the band concert is still scheduled for tonight.**

People show up to the doors (locked) wanting to get in.	**You have lost cell phone service.**
You receive an e-mail from the Emergency Manager.	**You receive an e-mail from the Emergency Manager.**

Maps given to Emergency Managers and School Decision Makers




LAKE
PORTER
LA PORTE
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ELKHART
LAGRANGE
STEUBEN
NOBLE
DE KALB
MARSHALL
KOSCIUSKO
STARKE
WHITLEY
ALLEN
NEWTON
JASPER
PULASKI
FULTON
WABASH
HUNTINGTON
WELLS
ADAMS
WHITE
CASS
MIAMI
BENTON
CARROLL
GRANT
BLACK-FORD
JAY
HOWARD
WARREN
TIPPECANOE
CLINTON
TIPTON
MADISON
DELAWARE
RANDOLPH
FOUNTAIN
MONTGOMERY
BOONE
HAMILTON
HENRY
VERMILLION
PARKE
PUTNAM
HENDRICKS
MARION
HANCOCK
WAYNE
RUSH
FAYETTE
UNION
VIGO
CLAY
MORGAN
JOHNSON
SHELBY
FRANKLIN
OWEN
DECATUR
SULLIVAN
MONROE
BROWN
BARTHOLOMEW
RIPLEY
DEARBORN
GREENE
JENNINGS
OHIO
SWITZERLAND
LAWRENCE
JACKSON
KNOX
DAVIESS
MARTIN
JEFFERSON
SCOTT
ORANGE
WASHINGTON
CLARK
PIKE
DUBOIS
FLOYD
GIBSON
CRAWFORD
HARRISON
POSEY
VANDER-BURGH
WARRICK
SPENCER
PERRY
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Appendix E: PBL Activity C, Greensburg Kansas Materials

Emergency Manager Guidelines

At each time stamp (yellow card) on the back of the card, answer the following questions:

1. What actions do you take?
2. Why do you choose to take those actions?
3. On a scale from 1-10, how concerned are you? (1= Not concerned at all and 10=Completely concerned)
4. What information do you want and need at this point?
5. On a scale from 1-10 how confused are you? (1= Not confused 10= Completely confused) What is confusing you?

Guidelines:

You are allowed to use radar throughout this exercise. However, you are only allowed to play the video that corresponds to the time on your most recent time stamp card.

If you decide an action is to e-mail or call someone, please draft what you would say on a blank sheet of paper provided.

Radar Tips:

Counties that are colored in yellow = Tornado Watch issued for those counties.

Orange boxes around storms = Severe Thunderstorm Warning

Red boxes are storms = Tornado Warning

Emergency Manager Time Stamp Cards

Wednesday May 2nd, 6:00 PM

You are watching your favorite news station and hear the following:

"We are expecting some severe weather on May 4th and 5th. We will keep you updated here on Channel 11. Visit our website for more and tune in at 11 tonight."

You look online at the Storm Prediction Website and see the following Day 3 Outlook that was issued at 6:00 AM this morning.

Thursday May 3rd, 12:30 PM

You noticed a new Outlook for day 2 was issued at 12:30 PM.

Thursday May 3rd, 9:00 PM

You decide to watch the news at 9:00 while you look at the Day 1 Outlook that was issued at 8:00 PM. You hear the following from the news station:

"Tomorrow and Saturday are going to be a big severe weather days, better make sure that storm shelter is cleaned out. We are expecting storms to happen in the late afternoon into the evening hours. Be sure to check with us, join us at 11 tonight."

Friday May 4th, 8:00 AM

You arrive at work in the morning and see the most recent Day 1 Outlook that was issued at 1:00 AM.

Friday May 4th, 3:00 PM You notice a mesoscale discussion was issued at 2:53 as well as another day 1 Outlook at 3:00 PM.	**Friday May 4th, 7:00 PM** You notice the Storm Prediction Center has issued a tornado watch for your area until 2:00 AM. You take a look at radar and notice some storms to your south in Oklahoma.
Friday May 4th, 8:55 PM You hear your weather radio go off saying there is a tornado warned storm. You pull up radar and look at the storm direction.	**Friday May 4th, 9:19 PM** You hear your weather radio go off again mentioning the town Greensburg in the warning information.

Friday May 4th, 9:30 PM

KIOWA KS-
928 PM CDT FRI MAY 4 2007

...A TORNADO WARNING REMAINS IN EFFECT UNTIL 1000 PM CDT FOR EASTERN KIOWA COUNTY...

AT 925 PM CDT...NATIONAL WEATHER SERVICE METEOROLOGISTS AND STORM SPOTTERS WERE TRACKING A LARGE AND EXTREMELY DANGEROUS TORNADO. THIS TORNADO WAS LOCATED 10 MILES SOUTH OF GREENSBURG...MOVING NORTHEAST AT 25 MPH.

THIS STORM HAS A HISTORY OF PRODUCING TORNADOES CAUSING SIGNIFICANT DAMAGE!

THIS VIOLENT TORNADO WAS APPROACHING HIGHWAY 183 AT 928 PM CDT ABOUT 7 MILES SOUTH OF GREENSBURG...EXPECT HIGHWAY 183 TO HAVE DEBRIS...TRA IS NOT RECOMMENDED SOUTH OF GREENSBURG AFTER THIS STORM PASSES.

THIS IS AN EXTREMELY DANGEROUS AND LIFE THREATENING SITUATION. A LARGE TORNADO HAS BEEN CONFIRMED!. IF YOU ARE IN THE PATH OF THIS DESTRUCTIVE TORNADO...TAKE COVER IMMEDIATELY IN A BASEMENT OR OTHER UNDERGROUND SHELTER AND GET UNDER SOMETHING STURDY.

Friday May 4th, 9:45 PM

You are continuing to watch radar.

Friday May 4th, 10:15 PM

You are continuing to watch radar. You notice it is moving out of your jurisdiction.

Emergency Manager Happenings Cards

At 9:47 PM you hear the local television station saying this tornado is going to hit Greensburg at 9:52 PM.	**You receive a phone call from the police chief; he wants you to do a morning briefing about what the weather is going to be like for the day**
Spotter reports tornado on the ground to your southwest.	**You have to get spotters into position.**

Spotters are calling you reporting large hail.	**Sister from down the street calls to ask if they should go to the basement.**
Spotter reports tornado on the ground.	**Farmer calls in saying part of his barn is gone.**

Law enforcement calling with numerous damage reports.	**You have lost cell phone service.**
You receive a call from a school district in your jurisdiction, wanting to know…	**You receive a call from a school district in your jurisdiction, wanting to know…**

You have received a call from the local hospital asking for a weather update.	**The nursing home in Greensburg, KS has called asking if they need to move their patients into the hall way.**

Information to Stakeholder Sheet

4. What is the date and time on your time stamp card? What Role are you playing?

_____

5. How would you like to contact them? (circle one)
    a. E-mail
    b. Landline Phone
    c. Cell Phone
6. What Message would you tell them?

_____
_____
_____
_____
_____
_____

They also had access to the weather data from the time including;

Convective Outlooks, Mesoscale Discussions, and Tornado Watches

School Rules and Guidelines

At each time stamp (each new page) please answer the following questions in the space provided:

1. What actions do you take?
2. Why do you choose to take those actions?
3. On a scale from 1-10, how concerned are you? (1= Not concerned at all and 10=Completely concerned)
4. What information do you want and need at this point?
5. On a scale from 1-10 how confused are you? (1= Not confused 10= Completely confused) What is confusing you?

School Schedule

6:00 AM - 9:00 AM	Buses Enroute
9:00 AM - 4:00 PM	Classes in Session (Elementary, Middle School, High School)
3:15 PM	Buses Leave Elementary School
3:35 PM	Buses Leave Middle School
4:05 PM	Buses Leave High School
6:00 PM	Buses Return to Garage.

Activity Schedule

Time	Activity	Place
6:00 AM-11:00 PM	Bus Leaves for Softball State	Away (120 Miles)
6:00 AM – 10:00 PM	Tennis State	Away (60 miles)
5:00 PM	JV Baseball Game	Home (High School)
8:00 PM	Varsity Baseball Game	Home (High School)
7:30 PM	Band Concert	High School

School Time Stamp Cards	
Wednesday May 2nd, 6:00 PM You are watching your favorite news station and hear the following: "We are expecting some severe weather on March 2nd. We will keep you updated here on Channel 11. Visit our website for more and tune in at 11 tonight."	**Thursday May 3rd, 9:00 PM** You decide to watch the news at 9:00 PM. You hear the following from the news station: "Tomorrow is going to be a big severe weather day, better make sure that storm shelter is cleaned out. We are expecting storms to happen in the early afternoon hours. Be sure to check back with us, join us at 11 tonight for a special extended forecast."
Friday May 4th, 8:00 AM You show up at school for the morning. The following is your schedule. Morning: 9AM-12PM : Morning Meetings Afternoon: 1:00-5:00PM: Meeting for school budget. 8:00 PM Go to Baseball Game to watch your son.	**Friday May 4th, 12:30 PM** You get back to your office and check your e-mail. You decide to look at the news station website for some information about the storms thinking about your son's baseball game. You see the following written. "The Storm Prediction Center is saying a moderate risk of storms this afternoon and early tonight. Be sure to keep us on and we will keep you updated"

Friday May 4th, 6:15 PM You hear your weather application on your phone set a tone off indicating there is a tornado watch for you area until 2:00 AM	**Friday May 4th, 8:30 PM** You can start to see lightning and hear thunder out at your sons baseball game.
Friday May 4th, 8:55 PM You hear someone say their weather application went off saying there is a tornado warned storm. You pull up radar on your phone and look at the storm direction.	**Friday May 4th, 9:19 PM** You hear the sirens go off and your phone tone for a tornado warning.

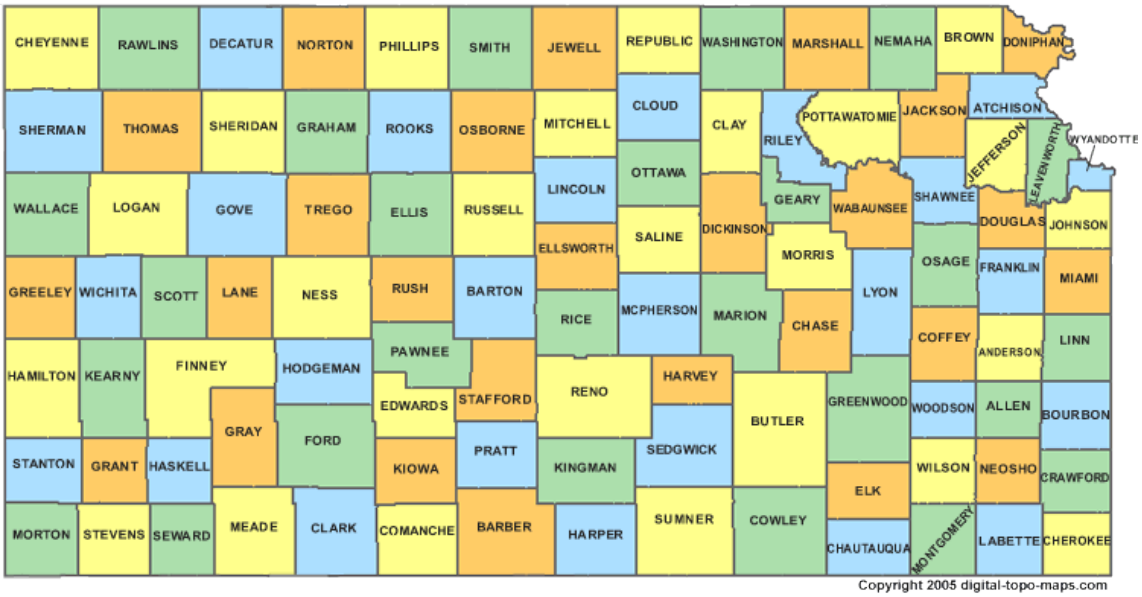
Friday May 4th, 9:30 PM Sirens are going off again, you look at your radar on your phone.	**Friday May 4th, 9:45 PM** Sirens are going off again, you look at your radar on your phone.
Friday May 4th, 10:15 PM You are continuing to watch radar. You notice it is moving out of your jurisdiction.	
School Happenings Cards	

Oops, you fell asleep and missed the 11 o'clock extended forecast.	**Softball Coach is calling you saying they won state! Also, they have left and are on their way home.**
You can see lightning and hear thunder getting louder.	**You have your own kids located at a different school site.**

Parents calling asking about baseball games tonight.	**Different parents calling to see if the band concert is still scheduled for tonight.**
Your maintenance guy is calling you saying people have shown up to the doors (locked) wanting to get in.	**You have lost cell phone service.**

You receive an e-mail from the Emergency Manager.	**You receive an e-mail from the Emergency Manager.**

Kansas County Map



Appendix F: Debrief Questions

1. What is hard about the school decision maker's job? (Asked to the emergency managers playing the role of school decision makers after activity A).
2. What is hard about the emergency manager's job? (Asked to the school decision makers playing the role of emergency manager after activity A).
3. What do you know now about the other role that before this activity you didn't? (Asked to both groups after activity A and B)
4. What information did you wish you had playing the roles that you were? (Asked to both groups after activity A and B).
5. Given the specific weather information, was is easy to make a time call and know what to do? (Asked to both groups after activity A and B).
6. After playing the role of an emergency manager, thinking about future events, does going through this activity change how you will interact with emergency managers? Why? How? (Asked to the school decision makers after activity A and C).
7. After playing the role of a school decision maker, thinking about future events, does going through this activity change how you will interact with school decision makers? Why? How? (Asked to the emergency managers after activity A and C).
8. As a whole, what did you think about the experience today? (Asked to both groups after activity C).

Appendix G: PBL Activity Pre/Post Questionnaire

Name: _____

Profession: _____

1. What type of information is readily available to you during a severe weather event?
2. What type of information do you need during a severe weather event?
3. What are your concerns on a severe weather day?
4. What kinds of tasks must you do on a severe weather day?
5. What kinds of distractions are present for someone in your role during a severe weather event?

In today's workshop you will be interacting with people in similar roles to you, and those that work in different settings (EM's and school personnel). The following questions ask you to think about the group that is different from you, and their information needs and experiences.

1. What types of information is available to the other decision makers during a severe weather event?
2. What are the types of information do the other decision makers need during a hazardous weather day?
3. What are the other decision makers' concerns on a hazardous weather days?
4. What kinds of tasks must the other decision makers do on a severe weather day?
5. What kinds of distractions are present for the other decision makers on a severe weather day?

Additional Post Activity Questions

1. Engaging in this activity affected how I will communicate with the other stakeholders in the severe weather decision making process in the future. Yes or No. Please Explain.
2. What was most valuable about participating in this activity?
3. What was least valuable about participating in this activity?