THE POLICY DEVELOPMENT OF DISASTER MANAGEMENT AND EDUCATION IN CHINA—THE COMPARISON BETWEEN POLICY EXPECTATION AND ACTUAL IMPLEMENTATION IN EARTHQUAKE PREPARATION DEMONSTRATION SCHOOLS

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This dissertation explored the differences between Chinese educational policy expectations and their actual implementation during earthquakes. It reviewed disaster management literature on education policy systems in UNICEF, U.S.A. and Japan. Their sheer complexity, especially related to coordination issues can be seen as “wicked problems.” A review of wicked problems theory was included in the research.

Communications between policy makers and field workers involved complicated issues of stakeholders, frameworks and interests. Integrating disaster management policy into functioning local educational systems was crucial. Teachers’ preparation and response activities in Ya’an’s provincial and national Earthquake Preparation Demonstration (EPDS) schools were studied because of their high levels of school safety before, during and after the 2013 Lushan earthquake. Well-trained teachers made heroic achievements in saving students’ lives. Comparing to 2008 Wenchuan Earthquake with thousands of students’ deaths and injuries, no students died or were severely injured during the 2013 Lushan earthquake, which drew me great interest in researching these good stories.

Mixed methods were utilized for the research. Document analysis was used to review EPDS policy expectations. This included detailed guidelines, knowledge training requirements, drill frequencies, etc. A survey asked teachers about their actual implementation policies. A descriptive statistical analysis was conducted, including the fact on preparation and response policies, as well as teachers’ reflections. A regression analysis was then used to analyze possible statistical significant relationships between EPDS preparation and teachers’ responses. Based on the findings, local teachers creatively adapted policies to achieve success. The preparation was statistically significant on affecting evacuation responses, and female has slight advantage than male on response activities. The results suggest potential value in scaling up the EPDS project in earthquake-prone region. Organizing EPDS teacher volunteer clubs may help to build momentum for gaining more support from government, communities and individuals.

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ADRC	Asian Disaster Reduction Center
CDC	Center of Disease Control (CHINA)
CEA	China Earthquake Administration
CPC	Communist Party of China
DRR	Disaster Risk Reduction
EASD	Earthquake Administration of Shandong Province (CHINA)
ED	U.S. Department of Education
EMAS	Earthquake Mitigation Administration of Sichuan □Province (CHINA)
EMAY	Earthquake Mitigation Administration of Ya’an □Metropolis (CHINA)
EPDS	Earthquake Preparation Demonstrative Schools
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
GMA	General Morphological Analysis
INEE	Inter-agency Network for Education in Emergencies
IRB	Institutional Review Board

NCDR	National Committee for Disaster Reduction(CHINA)
NERL	National Emergency Response Law(CHINA)
NGO	non-governmental organization
NIMS	National Incident Management System
SARS	Severe Acute Respiratory Syndrome
SAWS	State Administration of Work Safety (CHINA)
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children’s Fund

PREFACE

This dissertation is submitted for the degree of Doctor of Philosophy at the University of Pittsburgh. The research described herein was conducted under the supervision of Professor Maureen W. McClure in the School of Education, University of Pittsburgh. This work is to the best of my knowledge original, except where references are made to previous work. Neither this, nor any substantially similar dissertation has been or is being submitted for any other degree, diploma or other qualification at any other university. This dissertation is original, unpublished, independent work by the author, Yuchi Song.

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1.0 INTRODUCTION

1.1 EARTHQUAKES: DEVASTATING DISASTERS AND THE PROBLEMS OF PREPARATION FOR AND COMMUNICATION ABOUT

Earthquakes are devastating disasters that have historically caused large economic and human losses. In ancient human history, earthquakes caused not only massive human casualties, but had far-reaching social consequences, as well. The Sparta earthquake of 464 BC had an approximate magnitude of 7.2, and it led to the uprising of Sparta's national slaves and damaged the relations between Sparta and Athens (Armijo, Lyon-Caen, & Papanastassiou, 1991). It was a major reason behind the Peloponnesian War. The Rhodes earthquake of 226 BC destroyed the magnificent Colossus of Rhodes and the city of Kameiros (Erel & Adatepe, 2007). The largest earthquake-caused human loss was recorded on January 23, 1556, in the Shaanxi Province of China. A magnitude 8 earthquake caused direct injury or death to approximately 830,000 people and greatly shook the reign of the Ming dynasty, due to the subsequent decline in local agriculture. The Ming dynasty was later destroyed by the uprising of hungry peasants (Hou, Han, Chai, & Han, 1998).

Although humans have made great achievements in science and technology in modern history, earthquakes are still unpredictable, devastating disasters (Geller, Jackson, Kagan, & Mulargia, 1997) that continue to damage human societies. The table 1 shows several infamous earthquakes of the last 100 years with their magnitudes and subsequent economic/human losses (USGS, 2014).

Table 1. Several devastating earthquakes with huge human or economic losses.

Date	Time (UTC)	Name	Place	Magnitude	Deaths	Economic Loss (USD)
12/16/1920	12:05	Haiyuan earthquake	Ningxia-Gansu, China	8.6	235,502	Unknown
09/01/1923	02:58	Great Kanto earthquake	Kanto region, Japan	7.9	143,000	204 billion
05/22/1927	22:32	Gulang earthquake	Gansu, China	7.6	40,900	Unknown
07/27/1976	19:42	Tangshan earthquake	Tangshan City, China	7.6	242,419	16 billion
01/26/2001	03:16	Gujarat earthquake	Gujarat, India	7.7	20,085	4.5 billion
12/26/2003	01:56	Bam earthquake	Southeastern Iran	6.6	27,000~31,000	5 billion
12/26/2004	00:58	Indian Ocean earthquake & tsunami	Off west coast northern Sumatra, Indonesia, caused tsunami	9.1	230,000~300,000	Beyond 13 billion
10/08/2005	03:50	Kashmir earthquake	Kashmir, Pakistan	7.6	87,000~100,000	5 billion
05/12/2008	06:28	Great Wenchuan earthquake	Sichuan Province, China	7.9	69,197 dead; 18,392 missing	140 billion
01/12/2010	21:53	Haiti earthquake	Haiti region	7.0	316,000	7.8 billion
03/11/2011	05:46	Tohoku earthquake and	Near the east coast of	9.0	18,184 dead; 2,668 missing	235 billion

Date	Time (UTC)	Name	Place	Magnitude	Deaths	Economic Loss (USD)
	06:15	tsunami	Honshu, Japan, caused tsunami and nuclear plant disaster	7.9		
04/20/2013	00:02	Lushan earthquake	Ya'an City of Sichuan Province, China	6.6	193 dead; 24 missing	14 billion

Because earthquakes have such devastating consequences and yet are very difficult to precisely predict, a crucial topic for researchers and practitioners in the public policy and education fields is how to effectively prepare people against earthquakes. There is still a popular common sense belief that earthquakes occur at the will of God, yet the preparation for and mitigation of earthquake effects is no doubt the act of men. Since we cannot specifically know when and where an earthquake will happen, it is only practical to provide effective policies and procedures to prepare people for earthquakes, especially those who live in earthquake-prone regions.

Primary and secondary school students are particularly vulnerable against such disasters. Compared to other groups, primary and secondary school students undertake more risk and vulnerability due to the average student age and less completed survival capacity. For example, there were 5,335 school children dead and 15,000 injured in the 2008 earthquake in Sichuan Province, China. This is a huge generational loss to the local region (UNICEF, 2009). Therefore, it is imperative that earthquake preparation policies for primary and secondary schools be established and implemented in at-risk regions. Many countries and organizations have taken the first step by designing a series of practical polices to improve school safety against earthquakes.

As a global organization focusing on protecting children and women, UNICEF has developed a Disaster Risk Reduction (DRR) framework to improve children's capacity against natural disasters (UNICEF, 2010). This framework emphasizes several aspects of disaster management, such as policy design, risk identification and assessment, preparedness, etc. Other international organizations are developing and implementing similar policies, as well, including the UN and Inter-agency Network for Education in Emergencies (INEE).

The United States and Japan have developed comprehensive preparation systems against earthquakes and other natural disasters. The U.S. Department of Education and the Federal Emergency Management Agency (FEMA) have provided numerous resources for school administrators and educators to help them effectively protect students (FEMA, 2012; U.S. Department of Education, 2010). Japan has a more practice-focused disaster education system, which requires all its policy procedures to be rehearsed regularly (ADRC, 2005). China is developing a project called Earthquake Preparation Demonstration School (EPDS) for the primary and secondary school system (China Earthquake Administration, 2013).

The aforementioned policy frameworks all face the same challenge: implementation. No matter how comprehensive or practical the policies are, they are useless to improve students' capacity against earthquake without actual and effective implementation. Such implementation requires the collaboration of multiple organizations and individuals. Different participants may hold different views on a project, which can slow down or deter implementation. A typical example is the dilemma of determining time allocation to earthquake and other natural disasters education in Japan when college exam preparation is such a strong priority (ADRC, 2005; An, 2012).

To maintain effective implementation, it is vital to convey information about policy expectations to schools. Among all the challenges of implementation, I believe that information sharing and communication play a critical role. If the policy implementers thoroughly understand the values and goals of a project, the practice of the project may be better executed with less drag force. Although other factors might affect the implementation, such as different focuses from different stakeholders (e.g., school teachers might need to ensure certain levels of academic performance among students rather than ensuring they have disaster protection skills and students might prefer to rest rather than spend time on non-academic subjects), improving communication is a fundamental and fairly practical factor to consider. Smoothing the communication between policy makers and implementers is a complicated task—governments often have complicated structures and hierarchies, and implementers may need to follow orders from multiple superiors. Such was the case with the EPDS project of China: earthquake agencies and education administrations both have the power to guide schools' activities and to implement the project, which means that information sharing and coordination among the two agencies and schools must be smooth enough with their common acceptance of EPDS (China Earthquake Administration, 2013). This issue is very complicated and can be defined as a "wicked problem" –a complicated and challenging problem that cannot be solved using linear approach (Camillus, 2008). The context of a wicked problem will be discussed in the following chapter.

1.2 THE STUDY DESIGN SUMMARY

1.2.1 Core question

Based on the aforementioned demonstration, this dissertation's core research question is

How did teachers actually understand and act in preparing/evacuating students before and during the 2013 earthquake in China? Was there any gap between policy expectation and implementation?

This question aims to compare the difference between policy expectation and actual implementation in earthquake preparation and education in primary and secondary schools. The research case was the EPDS schools in Ya'an City, China, which suffered a high magnitude earthquake on 04/20/2013 (last earthquake on table 1). This case was selected due to its low death and injury count relative to the 2008 Sichuan earthquake. There were no students who died in schools in the Ya'an City earthquake, which is a huge improvement compared to the thousands of students who died and were injured in Sichuan in 2008.

The EPDS project was initiated in Sichuan's Shandong province several years before the 2008 earthquake, and it was proven effective to save children's lives in the 2008 disaster (table 2). During the 2008 Sichuan earthquake, there were 92 EPDS schools in the affected region, and only 2 schools had student deaths or injuries: one had 2 and the other had 392. The 392 deaths and injuries were caused by a landslide that occurred; it is likely that the building's structure would have held strong if not for the landslide. On the other hand, there were around 4,000 non-EPDS schools in the affected region: 3,339 were destroyed and student deaths and injuries were 5,335 and 15,000, respectively (EASD, 2010).

Table 2. Damage comparison between Non-EPDS and EPDS schools in the 2008 Sichuan Earthquake.

	Non-EPDS schools	EPDS schools
Number	Around 4,000	92
Schools Destroyed	3,339	1
Deaths/Injuries	5,335/15,000	392/2

Following the 2008 earthquake, adding more schools to meet EPDS standards became a strong priority in China. The 2013 earthquake tested these EPDS schools, and there were no deaths or injuries. This zero death result arouses my curiosity about how teachers implemented EPDS standards in the actual circumstance of the 2013 earthquake.

By comparing the policy expectation and the actual preparation and response of teachers during the 2013 earthquake, this research aims to assess how teachers understand and implement the policy makers' expectations about earthquake education. The effect of information communication in the EPDS project can be estimated through this exploration.

To answer the core research question, this study separately analyzed the policy expectations and policy implementations. The first analysis was on the initiation, development, and design of the EPDS framework. This was a document-based analysis. The second analysis was based on a survey to teachers of EPDS schools in Ya'an City. This empirical analysis collected and analyzed data regarding preparation and evacuation in order to portray the actual implementation of EPDS by teachers. Finally, the outcome of survey analysis was compared with the policy expectations with an eye to discerning the differences between the two and the effect of information communication. Several policy recommendations were provided according to the results.

1.2.2 Supporting questions and review

To broaden the context of this study and gain a better understanding of the circumstances surrounding the core research question, several supporting research questions were answered first. Firstly, before supporting questions, there is a review of disaster management in education systems in a global context, including the policy development of UNICEF, the United States, and Japan. These selected cases have their own unique features, which will broaden the understanding to the entire research area.

The two supporting questions are: What is the current policy development for disaster management in China? and What is the wicked problem in information communication and coordination in this inter-organizational context? The first question provides a general background on the current disaster development situation of China. The second question requires demonstration of what constitutes a wicked problem and then shows why information communication is a wicked problem in the context of education about earthquake and other natural disasters preparation.

The research question and the supporting questions in this study are as follows:

Research questions: How did teachers actually understand and act in preparing/evacuating students before and during the 2013 earthquake in China? Was there any gap between policy expectation and implementation?

Supporting questions:

1. **What is the current policy development for disaster management in China?**
2. **What is the wicked problem in information communication and coordination in the inter-organizational context of disaster preparation education?**

1.3 SIGNIFICANCE OF THE STUDY

The core question has unique value for Chinese earthquake administrators and educators. Currently, major focuses and funding are directed to earthquake prediction and forecast in China, while the education of preparation and mitigation is still a secondary concern of the government and society. By analyzing the EPDS project, this study could highlight the importance of earthquake preparation, which is a cost-effective and practical method to avoid earthquake-caused losses. High-tech methods of prediction require large monetary investments and have no guaranteed effects, particularly not in the near future (Geller et al., 1997). On the contrary, preparing students with drill and evacuation skills will no doubt improve the outcomes of disaster mitigation and preparation in China. The study aims to draw attention to the effectiveness of preparation in the hopes that doing so will cause society and the government of China to consider it a primary concern.

The supporting questions also contribute to disaster education. Comparing the features of different countries and organizations' policy frameworks for disaster education provides a global view for both researchers and practitioners. Understanding the pros and cons of these policies may enlighten policy makers and implementers to improve their current theories and practices and thereby save more lives. By analyzing the situation as a wicked problem, the study was able to define the problem of communication and provide another angle from which to view the field of education and disaster management. It may potentially generate additional solutions to the complicated problems in this field.

2.0 LITERATURE REVIEW ON DISASTER MANAGEMENT IN EDUCATION SYSTEM IN A GLOBAL CONTEXT, AND COORDINATION AS A WICKED PROBLEM DURING DISASTER PREPARATION/EDUCATION

This chapter is a literature review to discuss the development of disaster management in education system in UNICEF, U.S.A, Japan and China. In addition, this chapter illustrated why the coordination and communication during disaster preparation/education is a wicked problem, as well as the context of wicked problem theory and its solution.

2.1 DISASTER MANAGEMENT IN EDUCATION SYSTEM IN A GLOBAL CONTEXT---REPRESENTING POLICY DEVELOPMENT OF UNICEF, THE UNITED STATES AND JAPAN

As the aforementioned chapter demonstrated, this section will broaden the context of the study. By reviewing several representative countries/organizations on disaster education policy, a general image is created to portray the general situation of this field.

2.1.1 UNICEF Disaster Risk Reduction (DRR) guidelines

When considering natural disaster management in education systems globally, many international organizations set standards, such as UNICEF (2008), as well as later UN Sphere Project and INEE (Inter-Agency Network for Education in Emergencies). Since INEE and Sphere standards learned context from previous UNICEF work, this paper takes UNICEF as the example to illustrate policy guidelines of international NGOs. As a large international organization focusing on protecting children and their caregivers, UNICEF has a major concern for students and school vulnerability against disaster. In many marginalized and poor areas of the world, students (especially young kids) and teachers have little knowledge on how to protect themselves from disasters such as earthquakes, tsunamis, and landslides. In these areas, the people and community have little capacity to handle such emergencies, and thereby increase the risk of disaster. UNICEF focuses on disaster risk reduction (DRR) as its main guideline (UNICEF, 2010). In order to do so, it helps to implement disaster preparedness and response phases for students and schools.

UNICEF's DRR effort is based on the United Nations' International Hyogo Framework for Action (2005–2015). The Hyogo Framework points out gaps and challenges in five main areas of disaster management:

- Governance: organizational, legal, and policy frameworks
- Risk identification, assessment, monitoring, and early warning
- Knowledge management and education
- Reducing underlying risk factors
- Preparedness for effective response and recovery (UNITED NATIONS, 2005)

Accordingly, UNICEF portrays its DRR actions on four major fields (UNICEF, 2010):

- Prioritizing DRR for children and women on the national and local levels
- Identifying and addressing the risks faced by girls, boys, and women
- Creating safer and more resilient conditions for girls, boys, and women
- Strengthening humanitarian preparedness, response, and recovery through capacity development

With this guideline, DRR increasingly supports less-developed countries to build risk resilience. Typical examples of UNICEF activities include "addressing underlying risk factors and building a culture of safety and resilience at all levels of society including families, communities and government" (UNICEF, 2008).

Developing DRR for children in eastern and southern Africa:

As a typical example of developing DRR, in the less-developed areas of eastern and southern Africa, UNICEF proactively participates in dialogue to advocate DRR that focuses on children. Currently, eight countries have created state-scale platforms for disaster reduction. In addition, UNICEF also works to implement DRR through the education system. UNICEF used a Netherlands grant to collaborate with participating countries and organizations and improve children's safety against disaster by improving school capacity (UNICEF, 2010). This included building safe school buildings, implementing emergency preparedness plans, and providing disaster risk reduction programs in school curriculums.

Table 3 shows specific actions taken to implement DRR in different African countries (UNICEF, 2010).

Table 3. DRR in African countries.

Country & Region	Actions
Across southern Africa	Supported regional cholera preparedness and response plans for flood situations.
Ethiopia	Created a database and routine collection process on district-level early warning data.
Kenya	Conducted a trial assessment on district-level vulnerability and capacity in order to assist disaster planning.
Madagascar	Supported the training programs of education officials on DRR.
Namibia	Provided technical support for the first national disaster risk reduction plan.
Rwanda	Supported construction of earthquake resilient and student-friendly schools and health centers.
Zimbabwe	Reviewed water, sanitation, and hygiene projects to help prevent wells and latrines from being destroyed and reduce the possibility of cholera outbreak.

Developing DRR through emergency preparedness and response in China:

UNICEF collaborated with the Chinese government and other partners to implement national natural disaster preparedness training into China's school curriculum (UNICEF China, 2011). Teachers and school administrators are taking school safety training provided by UNICEF and safety mapping and evacuation drills have been implemented. Furthermore, this partnership has created safety codes for school buildings and guided school reconstruction in earthquake-stricken regions such as in the provinces of Sichuan and Gansu.

During the disaster response phase, providing for children's specific and urgent needs in disaster is a top priority for UNICEF China (UNICEF China, 2010). These needs may include housing supplies, food and water, school tents and classroom supplies, and health and nutrition care. UNICEF also works on school recovery after disaster strikes. UNICEF China considers the recovery to be an opportunity for sustainable development, or what it calls "building back better" (Retrieved from UNICEFChina.org). The practice for this ideal includes redesigning school buildings with sustainability in mind, which includes features such as providing water supply pipelines and hand-washing facilities in some of the less developed areas, such as Wenchuan and Yushu counties.

2.1.2 The policy-focused disaster education in U.S. --- United States Department of Education guidelines and FEMA frameworks and toolkit

In the education sector, the United States federal government has a comprehensive focus on the emergency management of both natural disasters and social emergencies. Such focus consists of various information and knowledge regarding to how to prepare schools against disasters. Multiple guides and information brochures are provided by the education and disaster management sectors of federal government. The U.S. Department of Education (ED) considers school safety in the fields of campus violence, drug abuse, pandemic preparation, hurricane, and several other natural disasters (ED.gov, 2011). The ED provides an action guide for emergency management at institutions of higher education (U.S. Department of Education, 2010), which covers multiple facets of emergency management based on the four phases of the disaster cycle: mitigation, preparedness, response, and recovery. These facets include organizing an efficient emergency team; identifying hazards, vulnerabilities, and threats; conducting risk assessment; and developing and implementing a practical emergency management plan. Campus violence has become a major concern since the tragedy of the Virginia Tech shooting, which caused large casualties and injuries. The ED, the Secret Service, and the FBI have worked together to compile a campus violence report in 2010 (Drysdale, Modzeleski, & Simons, 2010), which was released to illustrate the comprehensive context of college social emergencies, including where and why the violence happens and how to avoid and respond to such incidents.

In the K-12 sector, the ED provides brochures of practical information to school administrators on crisis planning (U.S. Department of Education, 2007). The brochure also portrays emergency management using the four-phased disaster cycle. In the mitigation phase, the ED considers the major goals to be identifying potential risk and providing assessments. Actions to take toward this end include the following:

- Connect with community emergency responders to identify local hazards.
- Review the last safety audit to examine school buildings and grounds.
- Determine who is responsible for overseeing violence prevention strategies in your school.
- Encourage staff to provide input and feedback during the crisis planning process.
- Review incident data.
- Determine major problems in your school with regard to student crime and violence.

- Assess how the school addresses these problems.
- Conduct an assessment to determine how these problems—as well as others—may impact your vulnerability to certain crises. (U.S. Department of Education, 2007)

In the preparedness phase, good planning and an effective response is the major concern. Actions to take in the preparedness phase are summarized as follows:

- Determine what crisis plans exist in the district, school, and community.
- Identify all stakeholders involved in crisis planning.
- Develop procedures for communicating with staff, students, families, and the media.
- Establish procedures to account for students during a crisis.
- Gather information about the school facility, such as maps and the location of utility shutoffs.
- Identify the necessary equipment that needs to be assembled to assist staff in a crisis. (U.S. Department of Education, 2007)

The response phase needs to follow through on the plan created in the previous phase. Highlighted points of action include the following:

- Determine if a crisis is occurring.
- Identify the type of crisis that is occurring and determine the appropriate response.
- Activate the incident management system.
- Ascertain whether an evacuation, reverse evacuation, lockdown, or shelter-in-place needs to be implemented.
- Maintain communication among all relevant staff at officially designated locations.

- Establish what information needs to be communicated to staff, students, families, and the community.
- Monitor how emergency first aid is being administered to the injured.
- Decide if more equipment and supplies are needed. (U.S. Department of Education, 2007)

The project of restoring normal school activities is the top priority for the recovery phase, which includes activities such as the following:

- Strive to return to learning as quickly as possible.
- Restore the physical facilities, as well as the school community.
- Monitor how staff members are assessing students for the emotional impact of the crisis.
- Identify what follow up interventions are available to students, staff, and first responders.
- Conduct debriefings with staff and first responders.
- Assess curricular activities that address the crisis.
- Allocate appropriate time for recovery.
- Plan how anniversaries of events will be commemorated.
- Identify "lessons learned" and incorporate them into revisions and trainings. (U.S. Department of Education, 2007)

As the major national emergency response agency, Federal Emergency Management Agency has taken many policy transformations to improve both policies and practices after the failure in response and recovery to Hurricane Katrina (Menzel, 2006; Schneider, 2005; Waugh, 2006), including the preparation for schools against crises. FEMA developed a series of frameworks to achieve the National Preparedness Goal (FEMA, 2014), as well as a comprehensive toolkit for multi-hazard emergency planning for schools (FEMA, 2012).

These frameworks, called the National Planning Frameworks, aim to improve the preparedness capacity of communities against the disasters. Such efforts were portrayed to achieve the National Preparedness Goal (FEMA, 2013c): “A secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk.”

Under the National Planning Frameworks, there are five frameworks based on the five preparedness mission areas addressed in Presidential Policy Directive-8 (FEMA, 2014):

- National Prevention Framework.
- National Protection Framework.
- National Mitigation Framework.
- National Response Framework.
- National Disaster Recovery Framework.

The National Preparedness Goal describes the core capabilities in the aforementioned five mission areas (FEMA, 2013c):

- Prevention: prevent, avoid or stop an imminent, threatened or actual act of terrorism.
- Protection: protect our citizens, residents, visitors, and assets against the greatest threats and hazards in a manner that allows our interests, aspirations, and way of life to thrive.
- Mitigation: reduce the loss of life and property by lessening the impact of future disasters.
- Response: respond quickly to save lives, protect property and the environment, and meet basic human needs in the aftermath of a catastrophic incident.

- Recovery: recover through a focus on the timely restoration, strengthening and revitalization of infrastructure, housing and a sustainable economy, as well as the health, social, cultural, historic and environmental fabric of communities affected by a catastrophic incident.

The core essence of these frameworks is to improve the emergency coordination and information sharing capacity among the entire nation. The National Disaster Recovery Framework was released in September 2011, and the prevention, mitigation and response framework were released in May 2013. The National Protection Framework is still working in progress and not released yet, and thereby we will not discuss it in this paper.

All the frameworks includes the following several key points (FEMA, 2014) :

- Explains the purpose of the document, including the guiding principles and scope of mission area.
- Summarizes the roles and responsibilities of each part of the whole community.
- Defines the mission area's core capabilities, along with key examples of critical tasks.
- Defines coordinating structures—either new or existing—that enable the whole community to work together to deliver the core capabilities.
- Describes the relationships to the other mission areas.
- Identifies relevant information to help with operational planning.
- Provides information that state, local, tribal and territorial governments can use to revise their operational plans.
- Uses concepts from existing preparedness efforts, such as the National Incident Management System (NIMS)

The frameworks emphasizes that the idea of the “whole community approach” (FEMA, 2014), which “recognizes that everyone can contribute to and benefit from national preparedness efforts. This includes individuals and families (including those with disabilities and others with access and functional needs), businesses, community and faith-based groups, nonprofit organizations and all levels of government.” Such approach hopes to mobilize and coordinate the capacity of all stakeholders in the community to work together, and help each other for disaster management (mitigation, preparedness, response and recovery).

The mitigation framework (FEMA, 2013b) aims to create a “platform and forum for coordinating and addressing how the nation manages risk through mitigation capabilities.” Mitigation can help reduce the damage of disasters by improving communities’ resilience through preparation activities, easing response, and accelerating the recovery procedures. It covers many facets of preparation guidelines from various facets. In addition, the structure of the framework follows the aforementioned key points design.

The response and recovery frameworks are guidelines on how the country responds to emergencies, as well as how the procedures of recoveries will be processed. The prevention framework, as the core capacity illustrated, is a guideline about preventing terrorism. These three frameworks also follow the aforementioned key point design. Since this paper focuses on the preparation and its implementation, we will not cover much of the above three contents.

Integrating with the National Preparedness Frameworks, FEMA provides a guideline for implementation for emergencies—National Incident Management System (NIMS). NIMS is a comprehensive, nationwide approach to emergency management. It provides templates for managing emergency incidents covering the detail of incidents’ cause, size, location and complexity. FEMA hopes NIMS can be applicable at all jurisdictional levels and across functional disciplines (FEMA, 2013a). NIMS provides a good reference to emergency workers and local communities on how to react to crises. It provides a dynamic system aiming to adapt the rapidly changing circumstance of emergencies. This guideline covers many principles on information sharing, resource management and other operations during emergencies. FEMA aims to integrate NIMS and preparedness frameworks, so that such policies may provide reference of best practices to disaster-related stakeholders on emergency management.

Other than the aforementioned general policies, FEMA also provides a comprehensive toolkit for multi-hazard emergency planning for schools (FEMA, 2012). Through documents and courses, this toolkit verbally and visually demonstrates how schools can prepare their students, staff, and administrators for emergency scenarios.

This toolkit has 14 sub-sectors. Each sub-sector not only includes the definition of different emergency management terms, but also consists of detailed sample course materials, survey forms, and resources. Tons of resources can provide school administrators with abundant choices and ways to implement their own emergency management processes. The governments of other countries can learn from this example and use digital platforms to provide practical guides for emergency preparation in the education system.

The ED’s brochure and FEMA’s policy efforts are two examples of U.S.’s achievement on developing disaster education with the principal of providing as much policies as possible. Yet the implementation of utilizing these policies into practice varies from state to state, school to school due to the decentralized school system of the country. There is no strict regulation to push schools to implement their disaster education based on these knowledge and information. Therefore, the effect of disaster education depends on individual school’s will and participation.

In addition, FEMA also has some problems as researchers have shown. In a decentralized political system as U.S., FEMA cannot mandate its frameworks and policies to local authorities (Sobel & Lesson, 2006). It makes FEMA policies become references to emergency workers in the field, and the latter workers may choose if they adopt such polices or not. Such problems involve multiple stakeholders in different levels of governments, local communities and individuals. Their different incentives and conflict of interest may cause the implementation of FEMA policies a complicated issue.

Though the practice of policy and agency implementation is still a problem, U.S. national agencies create benchmark for many countries on establishing disaster education standard due to their development on disaster education knowledge and policy. In addition, FEMA and ED's efforts indicate they are adaptive to rapidly changing dynamic of disaster management, and are willing to listen to criticism, as well as taking substantive steps toward change. Not all countries have such a capacity and comprehensive work for policy improvement and adaptation, specifically pertaining to the education system. Many countries consider school preparation to fall under their national emergency guidelines. China is one such country that does not provide detailed guidelines for schools to follow in the event of an emergency.

2.1.3 The practice-focused disaster education in the schools of Japan

The disaster education program in Japan's schools were triggered and propelled by the devastating 1995 Kobe earthquake, which collapsed hundreds of buildings and killed more than 6,000 people in western Japan. The economic loss that resulted from the disaster was near 10 billion USD (Shiroshita, Kawata, & Collins, 2009). The Kobe earthquake changed the Japanese public's opinion on Japanese disaster management; before, they had believed it to be good, but following, they realized that some changes needed to be made. The disaster education before the Kobe earthquake was mainly the evacuation drill, which trained students and teachers how to evacuate the school building in the event of an emergency (ADRC, 2005). Such drills were conducted twice a year in most of the schools in Japan, and students did not take the drills seriously, since they believed that earthquakes were rare incidents that hardly affected them (Maiko High School Homepage, 2006). After the Kobe earthquake, people changed their minds.

School buildings damaged by the Kobe earthquake stimulated Japan's Ministry of Education to reconsider its disaster education and management policy (Shiroshita & Kawata, 2007). Several reports were thereafter released to emphasize the importance of improving schools' resilience against disaster. Research has been conducted to explore how to improve disaster education and provided a theoretical base for practical implementation of current disaster education systems.

The disaster education program in Japan shifted from response-only drills to teaching a comprehensive understanding of disasters, including awareness of potential risk, knowledge of kinds of disasters, and survival skills (Shiroshita & Kawata, 2007). Implementation of this knowledge into practice is the main feature of disaster education in Japan. Unlike U.S., the centralized school system in Japan pushes better practice with the knowledge explored after Kobe Earthquake. The following example shows how a government developed knowledge framework is implemented by a high school.

Hyogo framework of disaster education and Maiko High School disaster education activities:

A good example is the disaster education framework developed by the Educational Board of Hyogo Prefecture (ADRC, 2005). The framework shows numerous survival skills that students should be equipped with to survive a disaster scenario. The framework’s core is to develop fundamental knowledge of disasters, develop fundamental skills of protection, and establish a strong will to cope with disasters and notice the significance of human lives and teamwork against disasters. The fundamental knowledge not only includes disaster knowledge, but also information about the surrounding social environment and disaster management techniques, such as the disaster life cycle of mitigation, preparedness, response, and recovery. In addition, students also learn how to help their community survive emergencies by participating as volunteers and donating supplies to people who desperately require them. Improving people’s awareness and alertness of disaster is also a crucial topic in this framework, so that students will not ignore the potential risk of human loss during disasters.

Maiko High School of Hyogo prefecture has introduced numerous disaster mitigation courses since 2002 and is a prime example of how to implement this framework. One third of the school’s lessons were used for disaster education for three years. Total disaster course hours were around 750 hours per students in these three years. Students proactively participated in various educational activities, which included listening to speeches by Kobe earthquake survivors, visiting disaster museums, making a safety map of the community, and conducting evacuation drills (Maiko High School Homepage, 2006) These lessons aimed to teach students not only how to survive, but also how to effectively support their friends, family, and community.

Shortcomings of school disaster education in Japan:

Despite its successes, comprehensive development of disaster education is not always successful in Japan. Maiko High School in Hyogo prefecture is an excellent example of how to improve disaster education, but there are still many shortcomings preventing effective disaster education in Japan's school system.

The first shortcoming is the time conflict between disaster education courses and general courses (Shiroshita & Kawata, 2007). Japanese students and schools place a heavy burden on passing college entrance examinations, which test subjects such as Japanese, math, and science. They do not cover any disaster education information. Because schools and students have to spend most of their learning time to prepare for college entrance exams, there is a lack of time available for disaster education.

Another shortcoming is that disaster education in Japan only focuses on several types of natural hazards, such as earthquakes and tsunamis. Some schools only educate students on fire evacuation procedures (ADRC, 2005). None considers potential social emergencies, such as campus violence, terrorist attacks, anticrime protection, and traffic safety.

2.1.4 Pros and cons of disaster management policy and implementation in the education systems of the U.S., Japan

U.S. and Japan have two paths on developing disaster education. As the aforementioned sections illustrated, U.S. has a significant development on policy of disaster education (Figure 1), while the practice implementation depends on different school's attitude and effort. Japan (Figure 2) has developed knowledge and information, yet their highlighted achievement is the implementation of practice for disaster education.

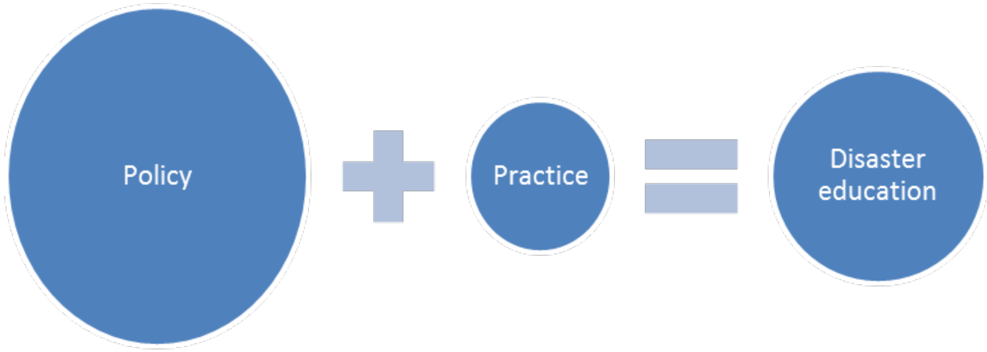


Figure 1. U.S.—Policy-focused disaster education

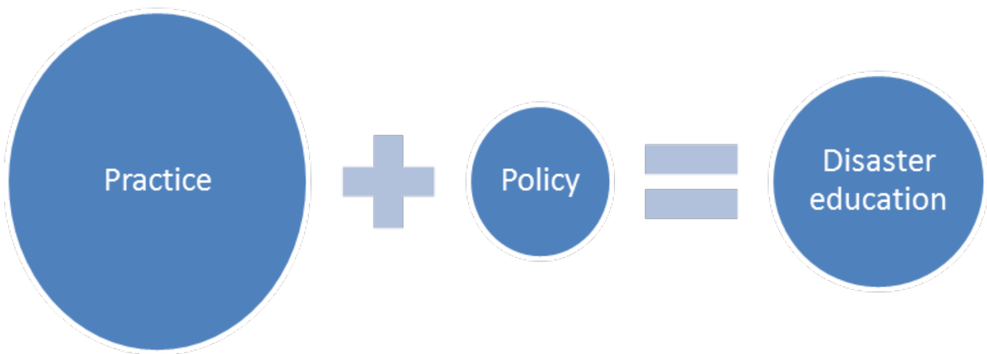


Figure 2. Japan—Practice-focused disaster education

In addition, table 4 provides a general comparison of the advantages and disadvantages of disaster management policies and implementation in the education systems of the U.S. and Japan. Of the two countries, the U.S. has developed a more comprehensive framework based on the disaster cycle of mitigation, preparation, response, and recovery in schools, yet the practice is the weak point. Japan has also developed effective disaster education covering the four-phase life cycle of disaster management with strong practice implementation, yet social emergency scenarios are more or less ignored, and schools find it difficult to spare enough time for disaster education due to aggressive concentration on preparing for high school and college entrance tests.

Table 4. Pros and cons of disaster management policy and implementation in the education systems of the U.S., Japan, and China

Country	Pros	Cons
U.S.	• Department of Education has developed massive information on how to prepare schools against emergencies, including both natural disasters and social emergencies. • Practical guidelines and frameworks have been illustrated so that school administrators can use these guidelines to conduct their own disaster education courses and plans. • FEMA provides an online toolkit as reference for schools regarding disaster education and a massive amount of forms, surveys, and course guidelines to help teachers train themselves and students to prepare for disaster.	• Due to the decentralized school system, the implementation of practice on the guidelines and frameworks differs from school to school. • Under this system, some schools may have highly developed disaster education plans, while others may not.
Japan	• Strong practice-focused disaster education. It comprehensively covers the life cycle of mitigation, preparation, response, and recovery. • Students not only learn survival skills for major disasters that might happen in Japan, but also gain fundamental knowledge about such disasters.	• Social emergencies are more or less ignored in the disaster education. • Schools can hardly spare enough time to comprehensively implement disaster education due to the

Country	Pros	Cons
	• Students are taught to contribute to disaster management in their communities by proactively participating in volunteer work and donating supplies.	pressure of studying for the college entrance test.

2.2 LEARNING LESSONS FROM DISASTERS—DEVELOPMENT OF DISASTER MANAGEMENT IN CHINA

2.2.1 The political system of China and its preliminary disaster management system

To understand the history of disaster management reform in China, the first step is to understand the political structure of the Chinese government. China has a one-party political system, and government power is highly centralized. There are three major characteristics of this system:

- The government includes both the administration system and the Communist Party of China (CPC) system. The CPC makes all decisions on choosing officials and commanding military forces, while the administration system follows and executes orders from the CPC.
- Since the CPC chooses the officials at every level of the government, lower level-only government follow orders from higher level. The state-province-municipal-county administrative regime forms government levels from central authority to local. Local authorities have little to no capacity for self-governance, and have less ability to gather resources.

- The development of non-governmental organizations (NGOs) is slow due to strict registration regulations. Therefore, the government and NGOs seldom cooperate. Citizen participation in public affairs occurs mainly through government guidance and order. (Zhang, 2012)

China's political system determines the development of disaster management. Before the SARS epidemic in 2003, China's preliminary disaster management system was based on a separation regime of several government branches (Ministry of Civil Affairs & China, 2009), including the departments of civil affairs, meteorology, water resources, agriculture, forestry, earthquake, marine, and geological mining. Under this regime, every branch separately copes with disaster by its own rules and approaches. In addition, natural disasters are the major focus of disaster management due to their massive scale economic loss to local communities and people. In the 1990s, China established the National Committee for Disaster Reduction (NCDR) to coordinate the disaster management of different branches and levels of government (Zhang, 2012). The formation of this committee was also a response to the United Nations' International Decade for Natural Disaster Reduction (Yang & Li, 2012). The NCDR only focused on natural disaster incidents, while other authorities coped with social emergencies. For example, epidemics were handled by the Center of Disease Control (CDC) and industrial accidents by the State Administration of Work Safety (SAWS) (Zhang & Tong, 2009b).

This separated disaster management regime was pushed to reform because of two major disasters: the SARS (Severe Acute Respiratory Syndrome) epidemic in 2003 and the devastating Wenchuan earthquake in 2008. An integrated disaster management system was established because of the lessons learned from these two incidents, which will be discussed in the following section.

2.2.2 Lessons learned from SARS and the Wenchuan earthquake

In 2003, the outbreak of SARS caused chaos statewide (Zhang, 2012). The Chinese government did not cope with the disaster in a timely and efficient manner. In addition, the government later admitted that government officials did not release the true number of cases, which caused rumors, social panic, and distrust of government credibility (Zhang, 2012). The lack of transparent information sharing caused misjudgment and affected the decision-making process. The disaster management system did not have disaster preparedness and mitigation measures in place.

The devastating, magnitude 8.0 Wenchuan earthquake happened in Sichuan Province on May 12, 2008. It was one of the biggest disasters since the founding of the People’s Republic of China in 1949, causing nearly 70,000 deaths, 18,000 missing, and 374,600 injured, with a direct economic loss of around 149 billion USD (UNICEF, 2009). Although the Chinese government won praise for its timely response and recovery for disaster relief, the disaster still exposed many problems in China’s disaster management system. Lack of joint command and coordination during the disaster, especially among military forces, administration, and other rescue forces (including volunteers and NGOs) caused the rescue effort to be inefficient and slow. The resource allocation process was less effective than it could have been due to the separate rescue efforts from the different government branches and military command (Zhang, 2012). Furthermore, there had been no preparation and mitigation measures in place before this incident (An, 2012).

According to the lessons learned from these two disasters, the Chinese government issued the National Emergency Response Law (NERL) (National Center for Disaster Reduction & Ministry of Civil Affairs, 2009). NERL focuses on transparent information sharing and immediate response to emergencies and establishes an accountability system for disaster management (Zhang & Tong, 2009a). The State Emergency Office was then established to jointly manage disaster incidents and emergency plans for every level of government (UNDP & China Lawe Society, 2009). Central and local authorities focused on disaster preparation and mitigation. Thereby, disaster education is now implemented through multiple platforms with various approaches. Evacuation drills are the main approach to prepare civilians for disaster, especially in massively populated units such as schools, factories, and department stores (Zhang, 2012). Education systems, especially the primary and secondary school system, operated disaster education under this guidance. Yet, compared to the achievements of US and Japan schools, such drills are far more than enough to comprehensively train students with surviving skills, knowledge and awareness, which will be discussed in the following section.

2.2.3 Lack of disaster education in primary/secondary school system

In the current education system of China, especially in the primary/secondary school system, disaster education is less developed. The main approach is to practice school evacuation for use in the event of fire, earthquake, flood, etc. (Du, 2010). Although school administrators are aware of social emergencies such as campus attacks and violence and place guards at school gates to protect students, they do not provide education to students for surviving such incidents (Liao, 2009).

Even evacuation drills are rarely conducted, due to the heavy burden on students and teachers to prepare for high school and college entrance tests. China is similar to Japan in that school curriculum design must focus on the subjects tested in the entrance tests. These include the subjects of Chinese, English, and math, but not of disaster education. Therefore, the majority of course time is allocated to test-relevant subjects, while there is little time for disaster education (An, 2012). In addition, students lack awareness of how serious disasters can be, and so they treat drills as an opportunity for games and leisure (Yang & Li, 2012). Schools also lack efficient survival tools and supplies such as flashlights, first aid kits, and emergency foods. Teachers are not professionally trained for emergency management and survival skills, so when disaster happens they do not have the knowledge to help students survive.

2.2.4 Recent improvement on the field of earthquake preparation

Though the current disaster preparation and education encounter several aforementioned problems and obstacles, there are still some improvements are made in recent years. Such improvements are firstly made in earthquake preparation field due to frequently happened massive earthquakes in China.

A series of policies and following framework were established to improve school and students' capacity against earthquake, and it has been conducted as pilot projects in selected schools. This project, called Earthquake Preparation Demonstration Schools (EPDS), originally developed from Shandong province, and it gained support from the central government due to its practical design and feasibility on implementation. The introduction chapter has mentioned several facts regarding to EPDS's practice and effective outcome. In addition, as previously emphasized, this study will focus on how this policy is designed/expected, and how it has been implemented in the case of one devastating earthquake.

2.3 DISASTER PREPARATION/EDUCATION—FROM POLICY EXPECTATION TO IMPLEMENTATION—A WICKED PROBLEM OF COORDINATION

As aforementioned section illustrated, countries and organizations have made many frameworks and roadmaps for disaster preparation and education to schools and children. The major two focuses are the expectations of the frameworks, and the implementation. Some countries are more focusing on developing comprehensive policies (such as U.S.); while others may focus on practice (e.g. Japan). Yet all the policy makers must face the same issue--- how to implement their expectations into actual and effective practice.

Many challenges might exist in actual implementations. Funding shortage is one major obstacle in many cases, especially in less-developed countries/regions. When various fields require funding support, such as health care, national defense and infrastructure development, these countries' poor financial situation hardly allow a sufficient budget pouring into disaster education. Another problem is the conflict of interest among different participating organizations. As the previous chapters illustrated, schools in Japan and China are focusing on students' academic performance since it is the major indicator to gain funding support and school reputation. On the contrary, policy makers focus on fulfill the expectations of the frameworks in disaster preparation/education. This is a typical conflict of interest among different organizations/stakeholders.

Among these challenges, one problem is fundamental and may include several other challenges--- the coordination. Under this study's circumstance, this term falls into an inter-organizational policy implementation. Conveying information among organizations might involve the negotiation of funding allocation and power/interest compromise. Yet I believe maintain effective coordination can greatly improve the implementation, not only through information understanding/sharing, also helping multiple stakeholders reach an agreement on practical implementation, including the factor such as funding, and interest sharing. It is no doubt improving such coordination is a complicated task, especially in a rapid changing environment such as a disaster-happened situation. This issue can be called “wicked problem” in a public policy theory. The wicked problem theory will be discussed in this chapter, and I will explain why coordination is wicked. Several ways to solve wicked problem will also be discussed.

2.3.1 Problems of coordination for inter-organizational policy implementation

When considering coordination policy and problems, the top priority is to understand how coordination is defined. At either an individual or inter-organizational management context, coordination is “organizing activity in such a way as to handle the problems that arise because the behavior of each participant depends in some ways on the behaviors of the others” (Simon, 2000). The need to share knowledge and communication depends on the characteristics of organization units and individuals. Highly interdependent units require more communication, while independent units require less mutual sharing (Simon, 2000). Managers and executives of private, public, and non-private organizations advocate for effective coordination to achieve better routine service, quick response when facing emergencies, and increased profit as the result of reducing the cost of management and ineffective collaboration (Comfort, Dunn, Johnson, Skertich, & Zagorecki, 2004).

Early researchers (Frey, 1982; Ostrom, 1986) believed that, to maintain effective coordination for achieving organizational goals, it was necessary to have regulated competition among organizations, groups, and individuals. They thought that this competition would increase organizational coordination through understanding their competitors. Recent research argues that effective coordination occurs when organizations understand one another and collaborate using computational techniques and networks (Comfort, KO, & Zagorecki, 2004; Gao, Barbier, & Goolsby, 2011; Goolsby, 2010).

Obstacles to effective coordination among inter-organizational systems tend to be those that prevent fluent communication. Scholars and practitioners have perceived these obstacles from many perspectives. According to Fesler and Kettl (1991), the problem of coordinating among multiple organizations can be summarized as a conflict between flexibility and regulation. When current communication systems among chains of command, units, and individuals are set to rules suitable for a certain circumstance, the coordination systems work fluently in that circumstance. However, several factors unrelated to the change of environment may affect the efficiency of the system. Such factors include multiple management levels, which increase the communication time among the units and the cognition gap among different individuals, thereby reducing the efficiency of collaborative work, and group work in higher coordination intensity situations, which increases the complexity and uncertainty of information communication (Grant, 1996).

Obstacles to coordination are often caused by a rapidly changing environment (Comfort et al., 2004; Simon, 2000). Current society is characterized by highly developed computational networks with a massive rate of information flow, which has a strong effect on the everyday lives of individuals (Gao et al., 2011; Goolsby, 2010). This rapid information exchange has the capability to provide solid intelligence or assistance for organizational activities. After the Haiti earthquake of 2010, for example, survivors posted numerous messages and photos on Facebook, Flickr, and Twitter, and these publications increased awareness of the situation to such a degree that disaster relief agencies received massive donations from people who were shocked and moved by the information that survivors shared (Morgan, 2010). However, the spread of rumors via the internet can also create obstacles for disaster management coordination. After the Wenchuan earthquake in China in 2008, internet rumors said that Beijing would encounter such an earthquake very soon. Panic among civilians created chaos in the capital of China, and disaster relief agencies had to publicly refute this rumor (Yu, 2008).

For a complex system working in a rapidly changing environment or competing with other changing systems, highly adaptive coordination structures are necessary (Simon, 2000). In such systems, the efficiency of sharing a common understanding of how to approach the changing situation is based on rapid adaptation to fluctuating information input. Yet the increased input of information reduces the efficiency for multiple organizations to achieve a mutual understanding (Comfort et al., 2004; Grant, 1996; Simon, 2000). For example, suppose that several groups come to a common approach on how to solve an issue, when suddenly a new piece of information dramatically changes the characteristics of that issue so that the previous approach does not fit the current circumstance. If several groups still follow the old approach while others change it to one more appropriate, the coordinated work might fail to achieve the desired effect.

Coordination obstacles cause more severe damage in the disaster management field due to the characteristics of disasters, which include: emergency, large casualties, and social and cultural loss (Comfort et al., 2004; Fiedrich & Burghardt, 2007; Hossain, Kuti, & Board, 2010). The rapidly changing environment is especially present when disaster strikes. Evaluations of disaster impact change constantly and emergency agencies must collaborate and relieve damage using a rapidly changing common approach, which is a challenge for any coordination system (Comfort et al., 2004; Hoard et al., 2005).

Coordination is even more challenging under the rapid information transmission speed made possible by social media (Gao et al., 2011; Goolsby, 2010). Facebook, Twitter, and YouTube provide individuals with opportunities to share information based on their own experience, views, and thoughts. This information is unverified and, in extreme scenarios, can cause rumors, chaos, and fear, which increase the coordination obstacles for agencies, since such rumors can affect the commonality of their understanding of and approach to the situation (Gao et al., 2011).

The following table provides the basic information provided by the literature reviewed in this section.

Table 5. Literature for coordination problems

Author	Focus sectors	Major points related to the coordination of obstacles in inter-organizational systems
Comfort, KO, & Zagorecki, 2004	Public/Non Private/General	Coordination is even more challenging in disaster management than other scenarios.
Comfort, Dunn, Johnson, Skertich, & Zagorecki, 2004	Public/Non Private/General	Rapidly changing environment causes obstacles of coordination.
Fesler & Kettl, 1991	Public/General	Coordination problem of organization is the dilemma between flexibility and regulation.
Fiedrich & Burghardt, 2007	Public/Non Private	Coordination needs improved information technology in disaster management field.

Author	Focus sectors	Major points related to the coordination of obstacles in inter-organizational systems
Frey, 1982	Public/Private	Competition improves coordination.
Gao, Barbier, & Goolsby, 2011	Non Private	Social media impacts coordination during disaster management.
Goolsby, 2010	Non Private	Social media is a new platform for coordination during disaster management.
Grant, 1996	Private	Insights on organization coordination through hierarchical command levels and individual cognition gap, etc.
Hoard, Homer, Manley, Furbee, Haque, & Helmkamp, 2005	Public	Computing technology and network improve coordination for pre-disaster planning.
Hossain, Kuti, & Board, 2010	Public	Assessed the viability of improving coordination for disaster planning using social networks. Found that information validity varies in social networks.
Ostrom, 1986	Public/Private	Competition improves coordination for organization behaviors.
Simon, 2000	General	A rapidly changing environment demands an

Author	Focus sectors	Major points related to the coordination of obstacles in inter-organizational systems
		adaptive coordination system.

2.3.2 Coordination is a wicked problem

The aforementioned section illustrated the complexity of coordination and information sharing, especially in an inter-organizational circumstance. In the beginning of this chapter, I argued this problem falls into the field of “wicked problem”, which, I believe, can better help the readers to understand the challenges from policy expectation to implementation, especially the problem of coordination. The following section will demonstrate coordination and its relation with wicked problem.

What is a wicked problem?

Wicked problem” (Rittel & Webber, 1973) is a word used to describe a problem much more uncommon than linear and logical problems. Rittel and Webber (1973) termed “wicked” the “non-definable design and planning problems that [were] extraordinarily complicated and challenging” compared to the regular, linear problems of mathematics, chess, etc. Following the definition of wicked problems, several existing problems can be considered wicked, such as: curing AIDS, deterring international crime, and responding to, and recovering from a massive-scale natural disaster (Tyszkiewicz, McCleskey, & Miller, 2012). These are all complicated problems that are challenging to solve.

Wicked problems have incomplete, contradictory, and changing requirements, and problem solvers are hard put to find effective solutions to wicked problems. The complex interdependencies regarding the problems add difficulties to the solution seeking process (Tyszkiewicz et al., 2012). According to Rittel and Webber (1973), solving one aspect of wicked problems may reveal or trigger another, even more challenging problem.

Many researchers agree that there is no universal definition for wicked problem. Some hold that a problem can be considered wicked when several properties of it are wicked (Camillus, 2008; Conklin, 2006; Degrace & Stahl, 1990; Rittel & Webber, 1973; Tyszkiewicz et al., 2012). Table 6 summarized ten properties of wicked problems that differentiate them from common difficult problems based on Rittel and Webber study (1973). It is not a strict guideline for locating wicked problems. Instead, it provides a reference by which to judge a problem as wicked or not.

Table 6. The ten properties of Wicked Problems

Property	Explanation
There is no definitive formulation of a wicked problem.	It is not likely to summarize a comprehensive definition of the wicked problem compared to a common problem.
Wicked problems have no stopping rule.	A common problem can be solved by a solution (or a series of solutions). However, seeking solutions for wicked problems never stops.
Solutions to wicked problems are not true or false, but good or bad.	Solutions for common problems can be evaluated as either true or false. Yet a solution to a wicked problem's validity more or less depends on the solver's judgment.
There is no immediate and no ultimate test of a solution to a wicked problem.	Solutions for common problems can often be immediately implemented to see

Property	Explanation
	whether or not they will work. However, solutions to wicked problems may cause unpredictable consequences over time, and thereby it is hard to evaluate the final effect of any given solution.
Every solution to a wicked problem is a “one-shot” operation; because there is no opportunity to learn by trial and error, every attempt counts significantly.	Solutions for common problems can be easily tested or abandoned. Yet the solutions used to solve wicked problems cause irreversible consequences.
Wicked problems do not have an exhaustively describable set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan.	Usually, common problems have a limited set of possible solutions, while wicked ones do not.
Every wicked problem is essentially unique.	A common problem belongs to a category of similar problems that are all solved in a similar way. Yet a wicked problem has no significant precedent. Solving each wicked problem introduces a piece of new experience without previous case.
Every wicked problem can be considered to be a symptom of another problem.	Common problems are self-contained. Yet, a wicked problem is entangled with other problems that are not all caused by one root reason.
A wicked problem inspires numerous explanations for the existence of a discrepancy.	A wicked problem involves many stakeholders who may have different opinions on the fact and the cause of the problem.
The problem solver has no room to be wrong.	Solvers of wicked problems are responsible for any consequences of the actions they take, and these actions may have an unpredictable impact on wicked problems.

Researchers in many different fields have provided insights on wicked problems. In the business strategy field, Camillus (2007) believes that the key features of wicked problems include a constantly changing environment and unprecedented challenges. After reviewing Rittel and Webber's (1973) demonstration, Camillus (2008) states that business executives agree they are facing wicked problems when five characteristics of the issues emerge:

a) The problem involves many stakeholders with different values and priorities.
b) The issue's roots are complex and tangled.
c) The problem is difficult to ascertain and changes with every attempt to address it.
d) The challenge has no precedent.
e) There is nothing to indicate the right answer to the problem.

In the project design field, Conklin (2006) used dialogue mapping to establish a shared understanding of wicked problems. Westcombe summarized Conklin's insight as "modeling group problem-solving dialogue in real-time on a laptop using an argumentation notation, or technique, which is displayed to the group on a projecting screen"(Westcombe, 2007). In the software engineering field, DeGrace and Stahl (1990) also adopted ways to spot and tackle wicked problems.

The Australian government (2007) provides insight into, and examples of wicked problems in the public policy arena. They believe wicked problems "go beyond the capacity of any one organization to understand and respond to, and there is often disagreement about the causes of the problems and the best way to tackle them." Several examples of wicked problems in the policy field include climate change, obesity, indigenous disadvantage, and land degradation (Australian Public Service Commission, 2007).

Some researchers, though not using wicked problem as the term, discussed about the challenging and complicated problems as messes. Ackoff described such problems as messes: “Every problem interact with other problems and is therefore part of a set of interrelated problems, a system of problems…I choose to call such a system mess (Ackoff, 1974,p.427). He believed the mess problems were consisted by many simpler problems, and these simpler problems may still be decomposed until unobservable level. Since we cannot solve a problem that we cannot observe, he argued that even the simpler problems is a “minimess” (Ackoff, 1974, p.428). In addition, he believed the problems of a mess is so interrelated that separately solving composing problems always fail as a solution for solving a mess.

Horn and Weber extended Ackoff’s demonstration, saying that “ a Social Mess is a set of interrelated problems and other messes. Complexity—systems of systems—is among the factors that makes Social Messes so resistant to analysis and, more importantly, to resolution.” (Horn & Weber, 2007, p.6) A social mess, based on Horn’s description, should have following features (Horn & Weber, 2007):

- No unique ‘correct’ view of the problems.
- Different views of the problems and contradictory solutions.
- Most problems are connected to other problems.
- Data are often uncertain or missing.
- Multiple value conflicts.
- Ideological and cultural constraints.
- Political constraints.
- Economic constraints.
- Often a logical or illogical or multi-valued thinking.

- Numerous possible intervention points.
- Consequences difficult to imagine.
- Considerable uncertainty, ambiguity.
- Great resistance to change.
- Problems solvers out of contact with the problems and potential solutions.

Horn's features reflected many researchers' definition on wicked problems. For example, he mentioned difference, multiple views, and uncertainty in the list, which is similar to the wicked problems' features, such as different stakeholders with different views, interests and solutions on the problems. In addition, Horn stated potential constraints for messes from cultural, political and economic areas. Such constraints may prevent solvers adopt necessary procedures (yet not within those constraints) for ease the complexity of the problems.

Either Ackoff or Horn's demonstration has viewed the wicked problems from different angles. Both messy and wicked problems illustrate a situation that some issues are way more complex to solve than simple linear problems (e.g. linear mathematic problems). In addition, these complicated issues always pop up in public policy and management area, especially the circumstance of a disaster management field (Degrace & Stahl, 1990; Roberts, 2000; Tyszkiewicz et al., 2012). The following section discussed the wicked problem in such area, especially for the information sharing and coordination process of inter-organizations, as well as implementation of disaster policy of Earthquake Preparation Demonstration Schools (EPDS).

Do Inter-organizational Coordination Problems in Disaster Management Constitute a Wicked Problem?

As the aforementioned section illustrated, two major problems prevent effective inter-organizational coordination in disaster management. The first problem is made up of factors unrelated to the dynamically changing environment. Such factors include multiple management levels, which increase the communication time among the units and the cognition gap among different individuals, which reduces the efficiency of collaborative work. Another such factor is that the group is working in situations with higher coordination intensity, which increases the complexity and uncertainty of information communication (Grant, 1996).

The other major problem is a rapidly changing environment of coordination (Comfort et al., 2004; Simon, 2000). Society is characterized by highly developed computational networks with a massive rate of information flow, which has a strong effect on the everyday lives of individuals (Gao et al., 2011; Goolsby, 2010). This rapid information exchange has the capability to provide solid intelligence or assistance for organizational activities. After the Haiti earthquake of 2010, for example, survivors posted numerous messages and photos on Facebook, Flickr, and Twitter. These publications increased awareness of the situation to such a degree that disaster relief agencies received massive donations from people who were shocked and moved by the information that survivors shared (Morgan, 2010). However, the spread of rumors via the internet can also create obstacles for disaster management coordination. After the Wenchuan earthquake in China in 2008, internet rumors said that Beijing would encounter such an earthquake very soon. Panic among civilians created chaos in the capital of China, and disaster relief agencies had to publicly refute this rumor (Yu, 2008).

Can these two problems of inter-organizational coordination be described as "wicked"? Rittel and Webber (1973) provided ten properties to describe wicked problems, while Camillus (2006) argues that a wicked problem has five factors. Of course, there is no universal standard to define whether a problem is a wicked problem. However, if a problem fits in some of the properties or features identified by Rittel and Webber (1973) and Camillus (2006), then certainly it is a complex and challenging problem, and thereby might be considered wicked.

Coordination problems fit in three of the Rittel and Webber's (1973) ten properties of wicked problems: wicked problems have no stopping rule; solutions to wicked problems are not true or false, but good or bad; and there is no immediate and ultimate test of a solution to a wicked problem. Table 7 describes why inter-organizational problems, especially in the disaster management area, are wicked problems with these three properties.

Table 7. Coordination Problems Fit Three Wicked Problem Properties

Property of wicked problems	How do coordination problems fit?	Examples
Wicked problems have no stopping rule.	In the context of inter-organizational coordination processes during a rapidly changing environment, a solution to solve a communication failure might not improve communication efficiency due to a change of environment. Therefore, problem solvers constantly need to seek new solutions.	During disaster response and relief, a nice way to improve information sharing is through the use of social networks, which provide a timely release of information. Yet rumors also spread through the same path. Problem solvers have to find new solutions to fight against rumors while gleaning the benefits of receiving real-time information.
Solutions to wicked problems are not true or false, but good or bad.	One solution may differently affect participants in a coordination problem. It may improve coordination efficiency to part of the group, yet it may not to others. Therefore, it is good	Improving informal networks among organizational participants may improve the efficiency of information sharing, especially during urgent situations. A field agent may contact the agency's

Property of wicked problems	How do coordination problems fit?	Examples
	to some participants, and not to others. It is not like a math problem with one true answer.	supreme executives if he has a personal relationship with them, and thereby save time and lives during a disaster. Yet if this path becomes regular, will the middle level manager be comfortable that his subordinate always goes over his head to find a higher manager, even if it is for a good reason? If this not-comfortableness causes the problem between middle level managers and field agents, middle managers may consider this informal network a bad solution that damages the normal communication.
There is no immediate and no ultimate test of a solution to a wicked problem.	The fact that communications problems fall under the no stopping rule indicates that more problems may arise after a solution is utilized, and so there is no ultimate test or immediate solution.	Adding a duplicated communication line as back up for normal communication is an approach to maintain coordination when normal one is dysfunctional. Yet the cost of duplication lines may causes financial difficulties to organizations, especially as a long-term plan.

The problems of inter-organizational coordination also fit within three features of wicked problems from Camillus's (2008) argument: a) the problem involves many stakeholders with different values and priorities; b) the issue’s roots are complex and tangled; c) and the problem is difficult to ascertain and changes with every attempt to address it.

During inter-organizational coordination, different units, participants, and managers are involved who might all have different perspectives or priorities. In a disaster response and relief scenario, the disaster manager team may include experts from multiple areas, such as a military rescue force, food supply unit, post-trauma psychiatric treatment group, and education sector. Each team member is likely to prioritize the to-do list differently. In addition, each may require different resources to meet their own priorities. The negotiation and communication among these team members complicates the solution of how to meet each unit’s needs.

The roots of coordination problems might be complex. If the problem happens due to the hierarchical communication structure of bureaucracy, then this root becomes political and thereby complicated, because improving the system might require the political or structural change of a current organization, which can affect every participant and cause unexpected consequences.

The volatility of the problem is shown in the aforementioned analysis on how the problem of inter-organizational coordination meets Rittel and Webber’s (1973) rapidly changing environment factor. The constant changing of an environment creates difficulty in tracking down a coordination problem. The problem itself may change due to the environmental shifting.

This review chooses several significant features of inter-organizational communication problems, which all indicate that the problem of inter-organizational communication is complicated and challenging. Although wicked problems are not yet clearly defined, I believe the problem of inter-organizational coordination is a wicked problem because it fits several criteria under the two models from Rittel and Webber (1973) and Camillus (2008).

The policy implementation for EPDS in China is a wicked problem, especially its communication/information sharing

Even without thoroughly exploring the EPDS framework and its expectation, I can still argue that conveying the context of EPDS to its implementers, i.e. teachers and students, is a wicked problem. There are various factors that influent the practice of implementation, such as power dispersion among stakeholders, funding support, awareness of implementers, conflict of interests, etc. All these factors are complicated to deal with, especially under a hieratical, large-scale and sophisticated social and government framework in China. Any possible bad action on one of the factors may deter the effective practice for EPDS. In addition, the factors are in a dynamic changing circumstance that they may hardly be static and controlled.

Meanwhile, it is no doubt the communication during practicing EPDS falls into inter-organizational circumstance. Policy makers from central, provincial and local government unanimously face a rapidly changing circumstance due to dynamic environment of earthquakes' intensity scale and complexity of stricken regions. The way of conveying information must consider different culture, economic situation, detailed school condition, etc. There is no stopping rule to meet all variables, and thereby the communication always needs to adapt suitable condition.

In addition, EPDS implementers may have different levels of understanding to the information. A comprehensive plan may be understandable to teachers in highly developed metropolis or earthquake-prone regions, due to their massive or direct way of receiving the knowledge of earthquakes, and thereby understand the importance of implementing earthquake preparation/education in their schools. Telling these teachers to implement EPDS is, in a matter of saying, easy if funding and other support is sufficient. While some implementers hardly feel the importance of EPDS possible due to its low awareness of earthquake, or other imperative issues to be considered, such as students' academic performance. Same coordination method might not work as good as its conduction to those who have higher awareness.

There is also no ultimate test for the coordination in EPDS, since the rapidly changing situation may prevent policy makers to estimate the effectiveness of communication between them and implementers. Too many variables may affect the practice and consequence of EPDS, such as funding level, the earthquake scale, etc. It is difficult for policy makers to know if the EPDS's effectiveness is due to good communication.

With the difficulty to figure out the effectiveness of coordination, it is still a meaningful work to see how EPDS teachers did in earthquakes, and it can reveal if the expectations of policy are met or not. If the expectations are met, then the EPDS is working, regardless of other factors' influence on the consequence. It is a way of solving wicked problem---simplifying/reducing the complexity by aiming only on one facet of the problem. This method partly reflects the thought of a solution to wicked problem----General Morphological Analysis (GMA).

2.3.3 Approaches to Solving Wicked Problems

Three Coping Strategies Based on How Power is Dispersed among Stakeholders

As Camillus (2008) argued, wicked problems involve many stakeholders with different values and priorities. Thus, one approach to solving wicked problems is to focus on the relations among stakeholders. Professor Nancy Roberts (2000) provided three strategies to solve wicked problems: authoritative, competitive, and collaborative. Her model is based on "the level of conflict present in the problem solving process, the distribution of power among stakeholders, and the degree to which power is contested" (Roberts, 2000).

Roberts' (2000) model explains the process of coping these three strategies under different power dispersions. When a problem emerges, problem solvers evaluate the difficulty of the conflict. Type I and II problems are less messy problems—they are not wicked and can be solved regularly (Roberts, 2000). If the problem is wicked—or type III—solvers then evaluate whether the power is dispersed or not. With concentrated power within a limited number of stakeholders, authoritative strategies are necessary to resolve the problem. If power is dispersed among stakeholders, the next evaluation focuses on whether the stakeholders are fighting for power or not. If not, collaborative strategies are feasible to solve the problem. If there is a struggle for power, coping competitive strategies are necessary.

The authoritative strategies hand the problem to a group or an individual, who solves the wicked problems while others (stakeholders, or even subordinates) accept whatever decisions the solver makes. Key characteristics of such problem solvers may include their expertise, experience, power, or position in a hierarchal organization. For example, the national central bank decides the interest rate. This authority determines the interest rate with its expertise, and all other commercial banks must follow the rate due to the law. This strategy may be effective when facing emergency situations if relief agent headquarters command all relief units with complete authority, which may save the cost of negotiation and communication if powers are held by different emergency relief agencies (Australian Public Service Commission, 2007).

The advantages of authoritative strategies are efficiency and time-control during the problem solving process. The disadvantages may include the potential narrow scope from the solver's expertise, which means that solvers might ignore aspects of the problem that lie outside the boundaries of their knowledge.

Collaborative strategies are utilized when power is dispersed among several stakeholders and there is no struggle for power among these stakeholders. When the solution to the problem more or less depends on the involved stakeholders' activities and attitudes, this strategy becomes essential. Joint ventures and international corporations are examples of when collaborative strategies are particularly helpful.

The advantage of collaborative strategies includes comprehensive coverage of the problem compared to authoritative strategies. The major disadvantage is the increased negotiation and communication costs among problem solvers, which is much less with authoritative strategies.

Competitive strategies are utilized when stakeholders compete among themselves for power and simply cannot agree on any solution. The core of this strategy is to compete for power through providing solutions from different stakeholders. For example, if two weapon manufacturers provide designs to compete for a next generation weapons system:

- The competition provides abundant innovations and new ideas. It may provide multiple choices for problem solutions. However,
- The competition might cause redundant resource consumption during multiple, simultaneous solution development processes. In addition, if competitors hold similar levels of power, and are able to prevent each other's solutions from being utilized, then the problem-solving process may end in a stalemate.

General Morphological Analysis (GMA)

General morphological analysis (GMA) was first developed by Professor Fritz Zwicky (1969) to solve extremely complicated problems. It is a method for "structuring and investigating the total set of relationships contained in multi-dimensional, non-quantifiable, problem complexes" (Ritchey, 2011).

As the aforementioned section demonstrated, wicked problems involve multiple dimensions and facets, and thereby cannot be solved with linear solution processes. GMA aims to "identify and investigate the total set of possible relationships in a given problem complex" (Ritchey, 2011). The analysis includes several steps (Ritchey, 1998).

1) Identify and define the parameters or dimensions of the problem complex.
2) Assign each parameter a range of relevant "values" or conditions.
3) Design a "Zwicky box," which is a morphological box, by setting the parameters against each other in an n-dimensional matrix.
4) Each cell of the box contains one value from each of the parameters, and thereby marks out a particular state or configuration of the problem complex.

The box contains three parameters, with each parameter having five values. Therefore, it comprises 5x5x3, or 75 cells. Each cell contains a value from three parameters. If we consider the box to represent a wicked problem with three major aspects, and each aspect has five solutions, then the final number of solution options for this wicked problem is 75. Therefore, comparing these 75 options and locating the best solution packets will solve this wicked problem.

GMA separates a wicked problem into as many aspects as possible to describe the problem, and then uses as many solutions as possible to address these aspects and establish a solution pool. Every aspect's solution composition describes a total solution for the problem. Therefore, GMA covers a wide variety of solution options to problem solvers, so that they can choose the right one based on their judgment. GMA may help problem solvers avoid the possible narrow scope that can be the result of limited expertise, experience, and knowledge.

GMA may have a disadvantage in that when a complex problem is separated into too many aspects, the process of discovering all possible solutions may become difficult and time-consuming. Therefore, utilizing dedicatedly designed GMA software might be a feasible solution when utilizing GMA to solve wicked problems (Ritchey, 2011).

3.0 METHODOLOGY TO EVALUATE INFORMATION SHARING BETWEEN THE EXPECTATIONS OF POLICY MAKERS AND THEIR IMPLEMENTATION BY SCHOOL TEACHERS OF THE EARTHQUAKE PREPARATION DEMONSTRATION SCHOOLS (EPDS) IN CHINA

The Earthquake Preparation Demonstration School (EPDS) project was initiated in the Shandong province (Chao & Li, 2012; EASD, 2003). The goal of the project was to increase primary and secondary school students and teachers' capacity to survive an earthquake when they are at school. The development of EPDSs in Shandong drew the attention of central earthquake mitigation administrators. The China Earthquake Administration (CEA) thought the project was a necessary step to increase school capacity against earthquakes on a national level. The central agency recommended that all provincial governments develop a similar pilot project and evaluate the effects of the EPDS program. Therefore, Sichuan province adopted the EPDS system into their schools via the Earthquake Mitigation Administration of Sichuan Province (EMAS), which resulted in the creation of a series of provincial and municipal EPDSs.

3.1 COMPARING FOUR PERSPECTIVES ABOUT THE ACTIONS OF EPDS

The EPDS, like many policies for disaster education, faces challenges from policy expectations to implementation. Conveying information to actual practice is affected by various factors such as funding, power dispersion, participant awareness, etc. These multiple complicated perspectives make the implementation a wicked problem. Therefore, the evaluation of the information sharing should involve comparison of multiple perspectives. To answer the research question:

How did teachers actually understand and act in preparing/evacuating students before and during the 2013 earthquake in China? Was there any gap between policy expectation and implementation?

This study compared four perspectives regarding to the actions of EPDS:

1. Perspective of EPDS policy documents on what EPDS teachers should do for preparation and training.
2. Perspective of what the EPDS teachers actually did for earthquake preparation and training.
3. Perspective of what the EPDS teachers believed worked best in preparation and training.
4. Perspective of regression analysis of the relationships between the preparatory actions and the teachers' reported responses during the earthquake.

The first perspective described the expectations of EPDS policy, especially the actions and work expected to be implemented by teachers. This was the policy makers' view on what schools should do to meet EPDS standards.

The second and third perspectives described the views of teachers in two separate ways: the second was what they actually did for preparation and how they responded during the earthquake. The third was what preparations/training did the teachers believed worked for them --- this perspective included the teachers' actions, as well as judgment of the success of earthquake education efforts.

The fourth perspective utilized regression analysis to explore if the preparations teachers made affected their reported responses. Some research (Shaw, Takeuchi, & Rouhban, 2009; Siripong, 2010) argued that effective preparation, including drills, disaster knowledge training, etc., improve teachers and students capacity to survive disasters. Therefore, this perspective hypothesized a conceptual model to describe the relationship between teachers' response during earthquake and the preparatory activities teachers did before earthquake. The Figure three describes this hypothesized relationship with an "+" arrow: I argue that the preparatory actions improved the teachers response during disaster. The analysis for the fourth perspective indicated if the conceptual model reflects the reality of the teachers.

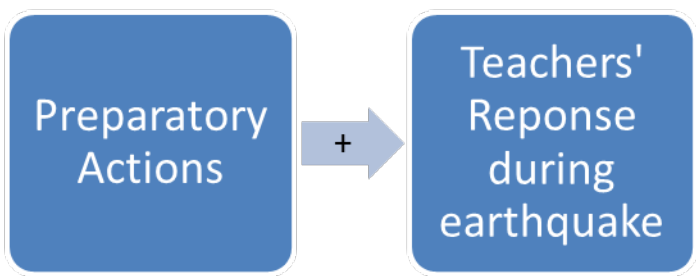


Figure 3. Conceptual model of the relationship between teachers' response during earthquake and preparatory actions they made before earthquake

These four perspectives attempted to describe the alignments between the policy makers' and teachers' understandings of the context of EPDS project. In addition, regression analysis tested the relationships between what teachers thought worked and how well aligned were their EPDS training and their practices during the earthquake. Comparing these four perspectives helped understanding the effects of information sharing among the policy makers and teachers, and may provide suggestions to improve EPDS project.

3.2 USING MIXED METHOD TO COMPARE THESE FOUR PERSPECTIVES

To compare these four perspectives, this study used a post-positivist framework (Guest, Namey, & Mitchell, 2013). According to Guest (2013), "Post-positivists accept the premise that a completely objective reality is impossible to apprehend but assume that research accounts can approximate, or at least attempt to approximate, an objective truth" (p. 7). Since information about all four perspectives can be collected and analyyzed, this study can begin to approximate a description of what happened, despite the expected interpretation biases.

To collect data for the four perspectives, a mixed method integrated quantitative and qualitative analysis based on different factors of the study. In this study, mixed methods combined document analysis, descriptive statistical analysis and regression analysis. The document analysis (Bowen, 2009) is a systematic procedure to review the contents of documents, and then gain the understanding of knowledge. These documents should exclude researchers' intervention. A typical example of using mixed method was conducted by Rossman and Wilson (1985) in evaluation of regional educational service agencies (RESA). They collected quantitative data through survey, and reviews of documents as qualitative data. The research outcomes combined the findings from both two types of data.

In the EPDS study, data for first perspective, EPDS policy expectations was retrieved from documents written by earthquake mitigation agencies in China, such as China Earthquake Administration, China Emergency Management Office, Sichuan Earthquake Administration, etc. These documents include EPDS standards, regulation on implementation, program evaluation guidance, etc. These documents are mostly located in authorities' office. I have gained permission and access from all above agencies to collect these documents. A document analysis reviewed the content of the documents, and thereby described the expectations of policy makers. The details of this section will be elaborated in 3.3 section.

The other two perspectives regarding to teachers' attitudes were collected from a survey. The survey takers are Ya'an city's EPDS teachers who have experienced 2013 Sichuan earthquake at school. Ya'an city was the epicenter of this earthquake, which was happened on April 20th, 2013 with great devastation (see introduction chapter). Both two perspectives (preparations teachers made, and actions they think it should work) was analyzed with descriptive statistics. The descriptive statistics described EPDS teachers' implementation, such as how many drills they have participated per semester, what kind of training curriculums they have conducted, how well they known the emergency evacuation plan, how fast they responded during earthquake, etc.

The fourth perspective about regression analysis was conducted based on the survey's data. It explored the relationship between the actions taken by teachers and the preparatory training they had. In addition to both policy-makers and teachers' perceptions of what was important in earthquake preparation, the regression correlates their preparatory and response activities.

The case of the 2013 Sichuan earthquake was selected due to its unique features to the research topic.

- The earthquake happened in the most earthquake-prone region of China—Sichuan province. This region has suffered from countless earthquakes since the devastating 2008 Sichuan earthquake. Therefore, the government has placed increased focus on implementing EPDS in this region.

- The 2013 Lushan earthquake was the second largest earthquake to happen in China since 2008. It caused massive damage to local infrastructures, yet the death toll was far fewer than that of the 2008 earthquake, particularly among students at school. This has direct application to my research interest on how the local educators worked against such a large-scale earthquake. Can we know if the new policies helped?
- Several heroic stories about how teachers saving children's lives were reported (EMAY, 2013). This increased my interest on how the teachers conducted such good practice.

The EPDS has been implemented in Sichuan province in a massive effort for the last five years. The Lushan earthquake tested the effect of the project. Therefore, this case represents EPDS implementation under actual earthquake-stricken circumstances.

I have gained permission from Ya'an Earthquake Administration to conduct this survey in EPDS schools. There were government officials and EPDS teachers to help me distribute survey and collect data. The detail about the quantitative method will be elaborated in 3.4 section.

3.3 DOCUMENT ANALYSIS ON EPDS POLICY EXPECTATION

Based on the aforementioned demonstration, the comparison of four perspectives were first separated into two sub-studies. The first sub-study focused on the policy expectations of EPDS. This sub-study included locating, gathering and analyzing data about EPDS policies, such as EPDS's goals, the outlined construction standards for school buildings, funding guidelines, training standards for teachers, etc.

The second sub-study collected data for three other perspectives, focusing on the teachers' actual implementation of EPDS, their understanding of the EPDS policy, and the alignment of these two. This second sub-study collected data about EPDS performance before and during the 2013 Sichuan earthquake.

After addressing all four perspectives, a final comparison analyzed the differences across policy makers' expectations and EPDS teachers' actions/perceptions. This comparison illustrated the findings on the process of conveying information and knowledge from policy design to practice and discuss what worked well and what did not. Several other factors, such as funding allocation or power dispersion for EPDS projects, may also be discussed.

3.3.1 Research approach of document analysis on EPDS policy expectation

As the above section described, document analysis was used for this sub-study. In section 3.2, I introduced a definition of document analysis, stating this approach is feasible for case studies and non-technical literature (Bowen, 2009). A typical example was Angers and Machemes's report (2005) using document analysis as a part to explore an ethnographic case study which revealed the beliefs, context factors for a multi-technology supported curriculum.

The documents of EPDS policy are mainly nontechnical, and do not include information that far beyond the knowledge level of EPDS teachers. In addition, exploring the development of EPDS project is a crucial factor while analyzing its policy expectation. Tracking the history of EPDS mostly relied on prior existing documents. This point also strengthens the application of using document analysis. Merriam (1988) believed such historical research may use document analysis as the only feasible approach.

The EPDS project originated in Shandong province, and our survey study was conducted in Sichuan province. Therefore, the documents covered the content from central government, Shandong province, earthquake-prone Sichuan province and survey-related Ya'an city. The documents mainly fall into the following categories:

- EPDS national, provincial and Ya'an city standards
- EPDS application guidance and process (schools must be qualified for standards, and then apply for the title of EPDS under certain application process.)
- EPDS school annual review in Shandong province
- EPDS school building standard
- EPDS training booklets and manual
- EPDS education video (video is also a type of document based on the context of document analysis.)

The following section discussed about the focus of the research, the source, location and permission of the documents.

3.3.2 Research focus

The focus was the policy expectation of EPDS policy, and the entire storyline of EPDS policy development in China. The beginnings of this story dated back to several years before the 2008 Sichuan earthquake happened. The goals and expectations of policy makers were the major concern in study. It described:

1. What kind of knowledge the teachers needed to know
2. What were the funding sources for EPDS

3. What kinds of training processes were intended to be conducted not only for staff but for students, parents, community members, etc.
4. How the earthquake intensity scale was defined
5. What were the newer school building standards designed against earthquakes

3.3.3 Source of data

This study utilized governmental policy documents from four major government agencies: the China Earthquake Administration (CEA), the Earthquake Administration of Shandong Province (EASD), the Earthquake Mitigation Administration of Sichuan Province (EMAS), and the Earthquake Mitigation Administration of Ya'an Metropolis (EMAY). Unlike various public accessible online documents in the United States, these Chinese documents are all located in agencies' offices. I gained permission from the directors of all these agencies to visit their offices and collect the documents.

3.3.4 Data analysis

The data was collected and categorized based on several standards.

1. First, the timeline for developing the EPDS was described.
2. Second, the study described the modification and diversity of EPDS ideas among these agencies and thereby analyzed how policy makers translated EPDS expectations into practical mechanisms for implementation.
3. Third, the analysis described how local policy makers integrated the national, provincial, and local levels of EPDS standards into local circumstances.

3.3.5 Trustworthiness and credibility

All the documents were pulled from the files of official Chinese agencies, and approved by the agencies that have the copyrights of these documents. In addition, I believe these are the best available data that I can collect.

3.4 METHODOLOGY FOR SURVEY ON TEACHERS' ATTITUDE, AS WELL AS REGRESSION ANALYSIS

The approach design for this sub-study is as follows:

3.4.1 Survey as an approach to collect quantitative data

This sub-study utilized multiple choice and open-ended survey questions to evaluate the issues of EPDS implementation in Ya'an metropolis. In the disaster management and humanitarian protection field, using surveys to collect quantitative data is a major approach for describing situation. The data and its following descriptive statistical analysis, such as mean/median of death/injury rate (Ali & Shah, 2000), standard deviation of inundation and run-up in a tsunami (Mori, Takahashi, Yasuda, & Yanagisawa, 2011), etc, provide readers with impression that the research is standard and generic (Krosnick, 1999).

International organizations who are working on humanitarian relief also prefer field surveys to collect data, and use the outcomes of descriptive analyses to support reports and documents (National Center for Disaster Reduction, Ministry of Civil Affairs, & UNDP, 2009; UNICEF China, 2011; UNICEF, 2009). A typical example was the UNICEF report conducted by Kondo (2013) on nursery school preparation and evacuation during 2011 earthquake/tsunami of Japan. The report used field surveys to describe how teachers conducted evacuation drills and other preparation, and how teachers responded when the earthquake happened. In addition, graphs and charts based on this quantitative data can create direct visual impressions, and deliver information with less text reading for fast readers (Center for Disaster Control and Prevention, 2008).

Only taking multiple choice (closed) questions in the survey has limitations (Krosnick, 1999), which is a reason open-ended questions are included the survey. One typical limitation (Bishop, Hippler, Schwarz, & Strack, 1988) is that respondents will choose the choices listed in the closed questions, even it is not their best answer.

Therefore, a survey combined with multiple choices questions (with open-ended choices added) was used to collect data for the perspectives of teachers. The detailed analysis on how to collect and process data was discussed in the following sections.

3.4.2 Research sites/participants

According to the current best available access I can gain from the region, the research sites was six counties in Ya'an metropolis. In this region, there were 12 fully functional EPDS schools when the earthquake happened; the targeted population is the EPDS teachers in these schools. Since I intend to collect data from teachers who have experienced both EPDS preparation/training and actual earthquake evacuation, I needed teachers who were at school when the earthquake happened, as not every school was in session at the time.

Using these guidelines, there was approximately 350 teachers considered to be covered in this survey. These teachers in EPDS schools in Ya'an were in school at the time of the earthquake. Since this was the total population of the pool, sampling was not necessary. These teachers had been more or less through the EPDS training process, and the tremor tested their skills. Finally, their participation in the survey was anonymous.

3.4.3 Survey distribution and collection process

In the field of disaster management and education, many researchers conducted surveys by distributing questionnaires (Mori et al., 2011) through email, paper copy or both of them, and usually the researcher (Kondo, 2013; UNICEF, 2009) will collaborate with local authorities and schools.

Therefore, with the assistance of EMAY (the Earthquake Mitigation Administration of Ya'an Metropolis) workers, I assigned the electronic version of the survey through Ya'an's online education network. Participating teachers printed the questionnaire and answer it. Then the survey was collected by EMAY workers, and mailed back to me. I covered the cost of the process.

This survey process was integrated with Ya'an EPDS training courses for teachers. Teachers may answer the survey in the classroom as a part of earthquake preparation curriculum (training teachers, not students). The teachers had full liberty to choose whether participated in the survey or not. In addition, they may choose to either answer or not answer any of the questions. It is voluntary.

3.4.4 Data analysis for teachers' reported preparatory actions and responses

The survey (see Appendices I) design was based on the policies and regulations of EPDS, as well as the ideas inspired by a recent trip in China. During the summer of 2013, I went to China to discuss this research with EPDS-related officials and educators. The director of China Emergency Office gave me valuable information regarding to EPDS policies and regulations, and the officials from both Shandong and Sichuan province earthquake administrations introduced first-hand implementation information on EPDS. In addition, I talked to educators and officials from Ya'an City about the survey questions, and they helped me fit questions to local circumstances. This led to modifications of some background information questions. For example, since all EPDS teachers at least held a junior teacher's school (a college level) degree, I deleted choices of high school and lower degrees when asking what the highest education the teachers have completed.

In general, the survey included requests for:

- Background information about teachers, including age, range, and education level.
- Teachers' views of disaster education.
- The kinds and frequencies of disaster education and training provided before the earthquake.
- What kind of actions teachers believes work best for earthquake preparation
- Their evacuation actions during the earthquake.
- Their reflections and suggestions for improvement of current disaster education policies and training after using their training during a real earthquake.

Descriptive statistical analysis was used to portray different facts about teachers based on the items of their region, whether they taught at primary or secondary schools, their response time, etc. In the survey, a major portion of questions intended to illustrate the teachers' information about and knowledge level of EPDS skills and rules. Others seek to discover how the teachers used the skills they learned, as well as what training activities they believed worked best. To find out the fact on perspectives of teachers, the analysis mostly utilized basic statistical indicators, such as mean, median, and standard deviation to describe the actions of teachers, such as the average drills EPDS teachers participate per semester, how many teachers have known well the emergency evacuation plan, etc. These indicators have been widely used demonstrate in research of humanitarian relief, disaster management and education (Kondo, 2013; Drysdale et al., 2010; Ministry of Civil Affairs & China, 2009; UNICEF, 2009; Yang & Li, 2012).

The reflections of these front-line teachers after the earthquake through open-ended questions may provide valuable practical suggestions for policy makers to improve the EPDS system and might contribute to larger policy issues related to changing the project from current demonstrative status to a more fully deployed stage.

3.4.5 Multivariate regression model, dependent variable and independent variables for 4th perspective ---a score system of recoding categorical variables into continuous variables

For the fourth perspective, my conceptual hypothesis is that more preparatory activities will improve teachers' response during earthquake.

To explore such relationship, introducing appropriate regression model becomes necessary. Currently there are tons of regression analyses, and different approaches are depends on the attributes of both dependent and independent variables. For example, simple linear regression is for one simple continuous independent variable and one continuous dependent variable. The ordered probit model (Long & Freese, 2006) is for categorical dependent variables with the ordered feature. In my survey, there were 11 questions asking about preparation facts, and six questions about response actions. These questions mostly have categorical designs, and put each single one of them into a regression indicates our model might have six dependent variables and 11 independent variables, even not including the control variables regarding teachers' age, gender and education. Such model becomes extremely difficult to conduct, and it is not the size of one dissertation may achieve. Therefore, recoding the questions was necessary to meet a much simpler regression model.

<u>Score system for question recode:</u>

Since there were many question asking about the preparation and response activities, simplifying these two groups of questions was the major concern. My goal was to recoding the design of the two groups into two variables: one dependent variable representing responses, and one independent variable representing preparation. Therefore, I designed a score system for the answers of the questions. The basic idea was that we give score, like a common course test, to each questions based on the weight of answers, then sum up the scores for both preparation and response. For 11 preparation scores, the full score is 37, and different questions have different full score based on the question/ answer design. For example, the question nine asking:

At work or in your community, have you received any form of training on the knowledge and skills needed for earthquake preparation, response and/or recovery?

The answer is *a.Yes* and *b.No*. If the respondent chose *Yes,* then she/he will earn one point, *No* with 0 point. The question 11 (full score as one point) and 12 (full score as one point) also follows the same rule.

The question 10 asking:

If you chose "Yes" in question 9, from whom have you received training (you can choose multiple answers)?

a. *Official training from national or international organizations/agencies, such as China Emergency Management Office, or National Earthquake Administration, or UN/UNICEF*
b. *My EPDS school training*
c. *Local community training*
d. *Self-learning through books, radio, video and Internet information about earthquake preparation*
e. *Other----please explain:*

This is a multiple selection question, which means the respondent can select more than one answer. I give answer *a. Official training* the highest score as four points, *b.EPDS school training* has score three, *c. local community training* as score two, and d. self-learning as score one. Such weight distribution is due to the fact of EPDS training situation. In centralized system of China, usually the authorities have better support from earthquake experts, and those experts are willing to help the authorities to conduct training, in which way they can gain official support for their own research, as well as public reputation (EASD, 2010; EMAS, 2012; National Center for Disaster Reduction et al., 2009). The authorities also have more resources to set up regulated training workshops and the following training framework. These are the reasons why the official training has the highest score weight. The following answer options have fewer weights due to their less of aforementioned capacity. The self-learning has the lowest weight since it is an informal approach to for teachers' to learn earthquake knowledge. There was no review to assure the effect of such learning. **We drop *other* option for weight in this question, and all *other* choice in the survey, since its answers cannot be predicted and weighted.**

To sum up, the full score of question ten was ten points, which played a critical role in a design of 37 as full score. That was because this question was the major one asking about teacher's knowledge learning activities on earthquake protections. Most other preparation questions were asking about their actual practice activities. I need to give a necessary weight in the design for preparation score, which including both knowledge (theory) learning and practice learning.

The question 20 also follows question ten rule that respondents can select different types of evacuation drills they experience, and the surprise drill has two points, and other drill types only weighted 1 point for each. This was because the surprise drill was recommended by EPDS policy (EASD, 2005; EMAS, 2012; EMAY, 2013).

Another type of question is one-selection question with weighted options, for example, the question 13 asking:

If you chose "Yes" in question 12, how much do you know about the plan?

a. I know the plan and we have regularly practiced what we would do

b. I know the plan and we have occasionally practiced what we would do

c. I know the plan and we haven't practiced it yet

d. I know some of the plan, but would need to ask someone about the details

e. Other----please explain:

This is obviously an order-weighted question, I scored each the highest score for choice *a I know the plan and we have regularly practiced what we would do,* and the following choices will have fewer score as: b for three, c for two and d for one point. The full score of this question is four points. Question 16, 18 and 19 also follow the same rule. **It is necessary to highlight that the questions 18 and 19 ask for the actual practice frequency about conducting training sessions and evacuation drills for students.**

The last type of question is a multiple-selection question with equally weighted answers. For example, question 14 asking:

Do you know whether your school had an earthquake resistance assessment and/or safety design in the last year (you can choose multiple answers)?

a. Building assessment to see how safe it is depending on the degree of 1seismic intensity (degree 8 in Ya'an EPDS)
b. Safety checks on emergency exits
c. Planned evacuation routes
d. I know there hasn't been a recent assessment, but there was one more than a year ago
e. I do not know if there ever has been one
f. Other----please explain:

The choices a, b and c has the equally weighted score as one point, since the options are EPDS regulated assessment procedures without special emphasize on any single one of them, and thereby they are equally weighted. The full score of this question is three points. The question 15, as well as many questions from preparation sections, follows this rule.

Therefore, the full score for preparation is 37. The following table 8 provides a breakdown on the design.

Table 8. Detail on preparations question and score

Question Number	Question Type	Full Score	Preparation Type
9	Yes/No	1	Knowledge learning of teachers
10	Multiple-selection with ordered weights	10	Knowledge learning of teachers
11	Yes/No	1	Knowledge learning of teachers
12	Yes/No	1	Practice learning of teachers (emergency plan)
13	Simple-selection with ordered weights	4	Practice learning of teachers (emergency plan)
14	Multiple-selection with equal weights	3	Practice learning of teachers (emergency plan)
15	Multiple-selection with equal weights	5	Practice learning of teachers (emergency plan)
16	Simple-selection with ordered weights	2	Practice learning of teachers (emergency plan)
18	Simple-selection with ordered weights	3	Preparing students frequency (knowledge)
19	Simple-selection with ordered weights	3	Preparing students frequency (drill)
20	Multiple-selection with ordered weights	4	Drill type
		Total score:37	

For the response session, I introduced a score called **best practice score.** The name of best practice indicates the score representing the best approaches of response during and after the earthquake.

There are six questions scored for best practice score framework. All of them ask about teachers' response when earthquake happened, as well as the following activities they did shortly after the tremor passed. The full score of best practice is 24. The following table 9 shows the detail breakdown of the question and scores.

Table 9. Detail on best practice questions and score

Question Number	*Question Type*	*Full Score*	*Preparation Type*
24	Multiple-selection with equal weights	3	Evacuation and protection when tremor started
25	Multiple-selection with equal weights	6	Procedures for protecting students after tremor
26	Multiple-selection with equal weights	7	Acquiring information about earthquake as EPDS required
27	Simple-selection with ordered weights	3	Evacuation location
29	Multiple-selection with equal weights	2	Procedures for protecting students after tremor
30	Simple-selection with ordered weights	3	Acquiring student safety information as EPDS required
		Total score:24	

Now we have recoded preparation and response into two variables: preparation and response scores. In addition, our regression model needs to control several other potential variables: gender, age, highest education teacher completed and teachers' attitude towards earthquake. Such data were collected due to the discussion with my academic advisor and Chinese EPDS experts in authorities, agreed and approved by them. We believe these factors may potentially affect the best practice as well.

The gender variable was recoded as female variable: when the answer is female, I code it as one and male as zero. Now gender becomes female as a dichotomous variable (dummy variable). Education was also coded as such dummy variable that one as undergraduate degree or above, and zero as the rest. It is because the data shows a predominately result of choosing undergraduate or above. Therefore, I will explore if such degree may affect the best practice. It will be discussed in the following finding chapter. The age question has both age range choices to choose, and a blank for respondents so that they may choose to write in the real age. Due to the feature of anonymous survey, the final data showed a very positive sign that nearly all the respondents provided their actual age, which makes me easy to consider age as a continuous variable.

The attitude questions include three categorical questions, and thereby I coded them as attitude score as well. The total attitude score is 10. The following table 10 shows the detail of coding.

Table 10. Detail on attitude questions and score

Question Number	Question Type	Full Score	Preparation Type
5	Multiple-selection with ordered weights	3	Attitude on earthquake threats possibility
6	Multiple-selection with ordered weights	3	Attitude on earthquake preparation/training
7	Multiple-selection with equal weights	4	Incentives driving teachers to participate in

Question Number	Question Type	Full Score	Preparation Type
			preparation/training
		Total score:10	

The Appendix B provides detailed questions with scores in the survey mode for reference.

Now we have all variables as either continuous or dichotomous (dummy) variables. The regression analysis becomes a relatively simple approach.

Multivariate regression analysis

Based on our recoded variables, I utilize the multivariate regression model to explore the relationships between best practice score and preparation score, as well as other control variables. This is a linear model summed up in the following equation:

$$Y_i = \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots \beta_p X_{ip} + \varepsilon_i, \qquad i = 1, 2, 3 \ldots n, \ldots$$

Y is the dependent variable. In our case, it is the best practice score. Xs are independent variables including preparation scores and other control variables. The β is the vector of regression coefficients which we wish to estimate. ε is the error term.

To further simply the model, I want to exclude any insignificant independent variables. Therefore, an approach called stepwise regression is introduced. Stepwise regression is an approach to regress multiple variables while simultaneously removing insignificant variables. In statistics, stepwise regression includes regression models in which the choice of candidates is carried out by an automatic procedure (Hocking, 1976). This procedure for model selection in cases where there are a number of candidates, and no underlying theory on which to base the model selection (candidates selection). The procedure starts with no variables in the model, testing the addition of each variable using a chosen model comparison criterion (F-test for correlation in our case), then put the candidates into the model for regression analysis based on its correlation with Y. The regression analysis itself has no difference from other linear regression. The only difference in stepwise regression is that it provides an approach to choose "good" independent variables.

The only two requirements for stepwise regression are that the variables should be either normal distributed or dummy, and there should be no collinearity among independent variables. The following finding chapter will show how our variables meet the two requirements. In addition, I will re-emphasize some detail on stepwise regression.

Meanwhile, a test for heteroscedasticity will be conducted to test if the variance of residual (error term) will remain the same (homoscedasticity). Homoscedasticity is a crucial prerequisite assumption for multivariate linear regression.

Combined with the analysis of descriptive statistics and multivariate regression analysis, the survey study will indicate how EPDS teachers implement and practice policy expectations when an earthquake occurs.

4.0 FINDINGS

4.1 THE DOCUMENT ANALYSIS FOR EPDS POLICY EXPECTATIONS

4.1.1 The development of EPDS project—From Shandong province to Sichuan province

The Earthquake Preparation Demonstration School (EPDS) project was initiated in the Shandong province. The goal of the project was to increase primary and secondary school students and teachers' capacity to survive an earthquake when they are at school. Classrooms in these schools are very crowded—the typical range of students per classroom in Shandong province is 40~50 (Iqilu, 2013). Therefore, a collapsed school building may threaten more children's lives than in any other public or private location. The safety of students is a major concern to educators.

Before the initiation of the EPDS project, schools in the Shandong province had no specific earthquake preparation activities. On September 20, 1995, an earthquake in the Cangshan County of Shandong provided a devastating lesson to the policy makers and educators in Shandong. The earthquake had a magnitude of 5.2, while the intensity scale in the epicenter was level 6. This mild intensive earthquake did not destroy any school buildings, yet 320 students were injured in school due to trampling during the chaotic evacuation (Chao & Li, 2012). Teachers ran away without organizing evacuation and students were panic—some jumped from the second or third floors of the building, while others dashed and trampled each other while running downstairs. One girl was heavily injured due to trampling while she was crouched over to tie her shoes.

This tragedy stimulated policy makers and educators to develop a framework to increase the capacity of Shandong schools against earthquake events. They developed a pilot project on earthquake mitigation and preparation in primary and secondary schools. In 2003, a joint operation was developed by the Earthquake Administration of Shandong Province (EASD), the Shandong Provincial Education Department, and the Shandong Association for Science and Technology. The first policy guidance that resulted from the operation was the “The notification on developing Earthquake Preparation Demonstration Schools-LuZhenFa2003-150”(EASD, 2003). This notification provides the basic concepts on EPDS, such as building standards, teachers/students training requirements, and the process of how to become an EPDS.

In addition, the 2003 notification listed the first 34 schools to become EPDSs. In 2005, a second notification added another 35 schools into the EPDS project (EASD, 2005), and another 96 schools became EPDS in 2007 (EASD, 2007). The fourth group of EPDSs comprised 152 schools, and was published in notification 2010 (EASD, 2010). Other than these provincial noticed EPDS schools, the cities and counties of Shandon also listed their own EPDS schools. The total EPDS in Shandong is 728. The table 11 shows the EPDS numbers as they stood at the end of 2010. The difference between provincial and municipal EPDS is the financial support source—provincial EPDSs receive the majority of funding from the provincial government, while the municipal governments provide the majority of funding for municipal schools. In the table, there are 30 EPDS meets all three standards, which indicate these schools earn the titles of provincial, municipal and county EPDS from these three level of authorities. Two schools earned

EPDS titles from both municipal and county government. Therefore, we can find out that **different level of EPDS is entitled by different level of authorities.**

Table 11. EPDS numbers by the end of 2010

Provincial EPDSs	Municipal EPDSs	County EPDSs	EPDSs that meet all three standards	EPDSs that meet municipal and county standards
348	269	143	30	2

The development of EPDSs in Shandong drew the attention of central earthquake mitigation administrators. The China Earthquake Administration (CEA) thought the project was a necessary step to increase school capacity against earthquakes on a national level. The central agency recommended that all provincial governments develop a similar pilot project and evaluate the effects of the EPDS program. Therefore, Sichuan province adopted the EPDS system into their schools via the Earthquake Mitigation Administration of Sichuan Province (EMAS), which resulted in the creation of a series of provincial and municipal EPDSs. By the end of 2012, this pilot project comprised 146 provincial EPDS and 267 municipal EPDSs in Sichuan (EMAS, 2012). In Ya'an City, according to the Earthquake Mitigation Administration of Ya'an (EMAY), there were 13 EPDSs established by the end of 2013 (EMAY, 2013).

4.1.2 China Seismic Intensity Scale

EPDS standards are based on the survivability of buildings during an earthquake. To regulate building quality, the EPDS utilizes the seismic intensity scale as the criterion for school construction. Unlike the magnitude scale, which objectively describes released seismic energy, the seismic scale portrays how severely an earthquake affects a specific place (U.S. Geological

Survey, 1989). It includes estimators of subjective human sensations, building damages, and objective kinetic measures. The building damage includes both subjective descriptions and scaling on the objective mean damage index (that is, how much of a building is destroyed).

In China, there is a national standard of intensity scale, called the China Seismic Intensity Scale. This was developed by the CEA and adopted and revised by the National Quality and Technology Supervision Administration in 1999 (D. Chen et al., 1999). The table 12 shows the narratives to describe this standard. The blanks in the table of light intensity part represents that the figures and phenomenon are too light to mention. The blanks in the severe intensity levels show that description of people and buildings is not necessary anymore; only large-scale landscape change will describe such intensity (D. Chen et al., 1999).

Table 12. China Seismic Intensity Scale

Intensity	Sensation of people on the ground	Degree of building damage		Other damages	Horizontal motion on the ground	
		Damages	Mean damage index		Peak acceler-ation m/s^2	Peak speed m/s
I	Unaware					
II	Feel by a very few, still, indoor people					
III	Feel by a few, still, indoor people	Slight rattle of doors and windows		Slight swing of suspended objects		
IV	Feel by most people indoors, a	Rattle of doors and windows		Obvious swing of suspended objects and vessels rattle		

Intensity	Sensation of people on the ground	Degree of building damage		Other damages	Horizontal motion on the ground	
		Damages	Mean damage index		Peak acceler-ation m/s^2	Peak speed m/s
	few people outdoors, and a few wake up from sleep					
V	Feel by most people indoors, most people outdoors, and most wake up from sleep	Noise from vibration of doors, windows, and building frames, falling of dust, small cracks in plasters, falling of some roof tiles, bricks falling from a few roof-top chimneys		Rocking or flipping of unstable objects	0 .31 (0.22 - 0.44)	.03 (0.02 - 0.04)
VI	Most unable to stand stably, a few scared and running outdoors	Cracks in the walls, falling of roof tiles, some roof-top chimneys crack or fall apart	0 - 0.10	Cracks in river banks and soft soil, occasional burst of sand and water from saturated sand layers, and cracks on some standalone chimneys	0 .63 (0.45 - 0.89)	.06 (0.05 -0.09)

Intensity	Sensation of people on the ground	Degree of building damage		Other damages	Horizontal motion on the ground	
		Damages	Mean damage index		Peak acceler-ation m/s^2	Peak speed m/s
VII	Majority scared and running outdoors, sensible by bicycle riders and people in moving motor vehicles	Localized destruction, cracks, but structures may continue to be used with small repairs or without repair	0.11 - 0.30	Collapse of river banks, frequent bursts of sand and water from saturated sand layers, many cracks in soft soils, and moderate destruction of most standalone chimneys	1 .25 (0.90 - 1.77)	.13 (0.10 -0.18)
VIII	Most swing about and find it difficult to walk	Structural destruction occurs and continued usage requires repair	0.31 - 0.50	Cracks appear in hard, dry soils, severe destruction of most standalone chimneys, tree tops break, and people and cattle at risk of death due to building destruction	2 .50 (1.78 - 3.53)	.25 (0.19 -0.35)
IX	Moving people fall	Severe structural destruction occurs leading to localized collapse and	0.51 - 0.70	Many cracks in hard dry soils, possible cracks and dislocations in bedrock, frequent landslides and	5 .00 (3.54 - 7.07)	.50 (0.36 -0.71)

Intensity	Sensation of people on the ground	Degree of building damage		Other damages	Horizontal motion on the ground	
		Damages	Mean damage index		Peak acceler-ation m/s^2	Peak speed m/s
		creating issues that are difficult to repair		collapses, and collapse of many standalone chimneys		
X	Bicycle riders may fall, people in unstable states may fall, there is a sense of upheaving ground	Most buildings collapse	0.71 - 0.90	Cracks in bedrock and earthquake fractures, destruction of bridge arches founded in bedrock, and foundation damage or collapse of most standalone chimneys	1 0.00 (7.08 - 14.14)	.00 (0.72 -1.41)
XI		Widespread collapse	0.91 - 1.00	Earthquake fractures extend a long way and there are many bedrock cracks and landslides		
XII				Drastic changes in landscape, mountains, and rivers		

4.1.3 The policy expectations of EPDS

The EPDS policy includes several factors:

1. How to become an EPDS
2. Building standards
3. Funding sources
4. Knowledge and skills necessary for EPDS teachers
5. Training processes for staff, students, parents, and the community

This section will not discuss the application process, for it is not the research focus of the paper. The following sections will illustrate the expectations of the EPDS policy for factors two to five.

<u>Building standards:</u>

According to EASD notification 2010 and EMAS notification 2006, EPDS buildings must not only meet the intensity scale requirements of the local region, but must improve its quality to meet one or two degrees higher than those requirements (EASD, 2010; EMAS, 2006). For example, in Ya'an City, the common earthquake survivability requirement is degrees VI or VII; therefore, an EPDS in Ya'an City must meet a standard of VIII on the intensity scale (EMAY, 2013).

Degree VIII describes a devastating effect of earthquakes, and the school building meeting such a standard can endure a massive scale of earthquake. Meeting this standard was a major reason why there was no significant school building destruction during the 2013 Lushan earthquake. The following pictures show the damage that was incurred in several school buildings in Ya'an City. Most of the cracks happened in the filling wall (the wall that fills the space between structural columns and walls), and the structural components of the buildings were not damaged (Figure 4-6).

Figure 4. Filling wall cracks--1

Figure 5. Filling wall cracks--2

Figure 6. Filling wall cracks--3

Funding sources:

According to the policy, funding amounts for EPDS building construction, modifications, training activities, and evaluations are based on the school's EPDS level. The provincial schools retrieve funding primarily from the provincial government, and local governments may support them as well if the financial situation is robust. The municipal EPDS is funded primarily by municipal governments (EASD, 2007; EMAS, 2012; EMAY, 2013).

Beyond governmental support, EPDSs receive donations from NGOs and philanthropists, especially in the earthquake prone region such as Sichuan Province, such donation played a crucial role in the EPDS funds. Many EPDS are built based on such funds. For example, Ya'an city's Yucheng No. 2 High School (a municipal EPDS) received ￥10 million ($1.65 million U.S. dollars) from Hong Kong philanthropists after the 2008 Sichuan Earthquake. The school building was re-constructed using this donation. The following picture shows a monument that memorializes this event (Figure 7).

Figure 7. The memorial monument for donation in Yucheng No.2 High School

Knowledge/skills teachers needed to know:

EPDS policy also requires that teachers be equipped with necessary knowledge on earthquake protection and evacuation (EMAY, 2013). Government officials developed a series of textbooks and manuals for teachers and students to help them meet the requirements. Such books review government policy on earthquake preparation, provide skills and knowledge about earthquake protection, and so on. (Figure 8)

Figure 8. EPDS text books

The knowledge and skills that teachers are expected to gain include the following:

- Understanding the China seismic intensity scale.
- Knowing the local seismic context, including earthquake history and potential future seismic events.
- Gaining earthquake protection skills, such as hiding under a desk or hard top when it is impossible to walk, evacuating to an open space when it is possible to walk, and remaining calm at all times.

- Having a plan for what do after an earthquake, such as organizing students and keeping them calm, checking for school safety, and contacting parents.

Teachers are also required to participate in workshops or curriculums about earthquake mitigation. These sessions are arranged by many kinds of authorities, including earthquake agencies, NGOs, and academic organizations. For example, EMAY arranges earthquake safety workshops at the beginning of every semester, and teachers are required to participate (EMAY, 2013).

The goal of the policy is for teachers to act as qualified emergency workers during an earthquake, so that they may protect students and themselves without professional assistance.

<u>Training processes for staff, students, parents, and community:</u>

The EPDS policy highlights that preparation is a crucial factor in earthquake mitigation. The training of students is the major factor of such preparation (EASD, 2005, 2007, 2010; EMAS, 2006; EMAY, 2013). Such training includes a multi-level approach that includes the following:

- Performing evacuation drills.
- Developing emergency survival kits.
- Conducting earthquake preparation competition and workshops.

The policy requires that every EPDS must conduct an evacuation drill at least once per semester. Such drills may include several features, including the following:

- Schools should prepare an emergency plan and highlight the evacuation route. Teachers must clearly know their role in evacuation, which can include guiding students through the route, staying at the turning corner of the stairway to reduce crowding when students walk down the stairs, and taking roll call after students evacuate to the safety zone. (Figure 9: evacuation route and plan)

- Handicapped students must be assigned to specific teachers, who will carry them down during evacuation.
- The element of surprise. This is because drills can be better evaluated when they are unexpected.
- The participation of parents and community members in the drill.

Figure 9. The emergency evacuation map

The following picture (Figure 10) depicts a typical drill in an EPDS in Shandong. Students cover their heads during the earthquake and evacuation, and a teacher carries a handicapped student during the drill.

Figure 10. Drill photos and the male teacher carrying handicapped student

EPDS policy makers intend to develop affordable emergency kits for schools for every classroom, as well. A comprehensive product has been released in Shandong, yet the current cost about the kit prevents it from being applied on a larger scale (Figure 11 & 12). The product requires further funding support and cost control.

Figure 11. The emergency kit --1

Figure 12. The emergency kit --2

EPDS policy also recommends that schools arrange student competitions on the topic of earthquake safety (Chao & Li, 2012). Such competitions include narrative reflection and picture drawing contests. They aim to strengthen the knowledge and skills of students through encouraging the transformation of reflection into graphic and verbal expression. Drawing competitions are usually conducted in primary schools, while narrative reflection is for older students.

The following picture (Figure 13-15) shows a drawing contest in Mingcheng School of Shandong. Students portray what they should do to protect themselves during an earthquake.

Figure 13. Drawing contest --1

Figure 14. Drawing contest --2

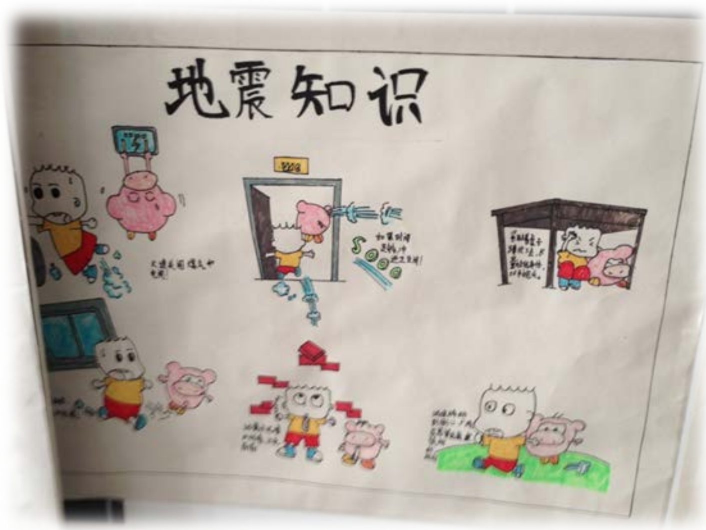


Figure 15. Drawing contest --3

4.1.4 The shortcomings of current EPDS policy

As a pilot project, EPDS still has several shortcomings. Currently there appear to be three major weakness of the policy.

First, the policy is still not officially regulated. It is instead under the framework of governmental "notification and guidance." This means there are no legal consequences for non-compliance. Government officials would usually warn them to meet the standards if they were falling short, but because there is no specific regulatory code for violations, there are no such warnings. For example, there is no specific rule outlining the consequences that will be incurred when schools do not meet the minimum drill frequency.

In addition, performance reviews of EPDSs do not guarantee consistent compliance. Schools may prepare only for governmental reviews or check events and disregard preparation opportunities the rest of the time. The government might ignore the power of parents and community on monitoring the EPDS performance. I believe parents and local community cares about their children's lives than any others, and they might be willing to oversee the implementation of EPDS activities.

Second, the power dispersion of EPDS development prevents efficient implementation. Currently, the EPDS is a joint operation among earthquake, education, and science agencies, and there is no platform for long-term coordination among these groups nor a central command for EPDS development. Agencies instead have taken actions based on their own interests (Chao & Li, 2012). In China's centralized system, such power dispersion prevents the further development of EPDS.

Third, the preparation and training does not integrate well with routine teaching activities. Schools are not willing to use the routine education schedule for earthquake training, and the primary focus of schools is still on preparing students for high-stakes exams. Training is usually conducted after class, and the inspiration to conduct and attend training is lower than to conduct and attend exam preparation (Chao & Li, 2012; EMAY, 2013)

4.2 SURVEY FINDINGS AND ANALYSIS FOR YA'AN EPDS TEACHERS

The survey covered 12 Earthquake Preparation Demonstrative Schools (EPDSs) that were open on April 20th, 2013, which was the date of the earthquake. To better portray the situation of each county of Ya'an City, the survey randomly selected two then-open EPDSs from each of the six counties. Since the earthquake struck on a Saturday, only 20 EPDSs were open, including primary, middle, and high schools (Table 13).

Table 13. Surveyed EPDS school by counties and level of education

	Yucheng District	Mingshan County	Yingjing County	Lushan County	Tianquan County	Baoxing County
Primary		1		1	1	1
Middle		1	2	1		
High	2				1	1

Among these schools, there are seven provincial level EPDSs and five local level schools. There are no national level EPDSs in the region. The following table 14 shows the prevalence of education levels and their EPDS levels.

Table 14. Surveyed EPDS schools by EPDS level

	Provincial EPDS	Local EPDS
Primary	4	
Middle	2	2
High	3	1

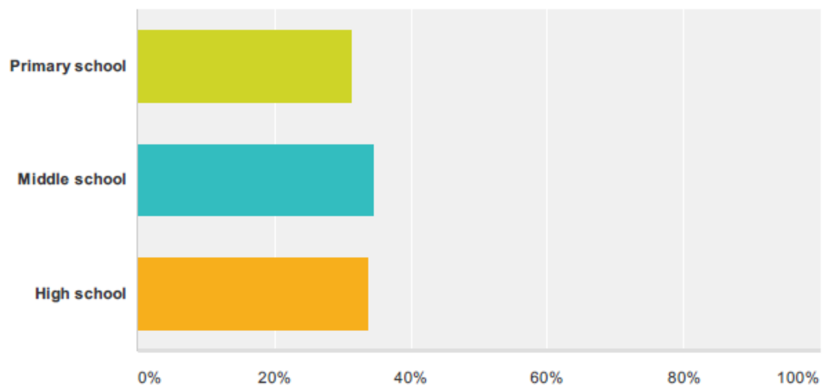
Each of the EPDSs has several hundred to several thousand students. The day of the earthquake, most of the senior grade students were at school preparing for their higher-level education entrance exams. These students comprise one-sixth (1/6) of the total school population in Ya'an Region (EMAY, 2013). The following table 15 shows the actual student population and respondent teachers present on that day. Among approximately 350 EPDS teachers who were present at school when the earthquake happened, 242 teachers responded to the survey respondents. The retrieval rate is 69.14%. The numbers accompanied by * are approximations of the number of students at school students using a 1/6 ratio. The schools are all anonymous, and simple numbering has been used to identify them for the purposes of this study.

Table 15. School number fact on students and teacher respondents

School ID	County	School Level	EPDS Level	Total Student Population	Students at School	Teacher Respondents
1	Lushan	Primary	Provincial	2,200	120	15
2	Lushan	Middle	Local	900	100	20
3	Baoxing	High	Local	1,500	580	20
4	Baoxing	Primary	Provincial	1,000	170*	18
5	Tianquan	Primary	Provincial	750	125*	21
6	Tianquan	High	Provincial	2,600	952	25
7	Yucheng	High	Local	1,800	300*	20
8	Yucheng	High	Local	2,400	400*	20
9	Mingshan	Middle	Provincial	2,400	600*	21
10	Mingshan	Primary	Provincial	2,000	330*	21
11	Yingjing	Middle	Local	1,300	217	21
12	Yingjing	Middle	Provincial	1,300	240	20

The average number of at-school students is 345 per school, and the average number of teacher respondents is 20 per school. Therefore, the average approximate student/teacher respondent ratio for evacuation is 17.25/1.

Among the respondent teachers, 76 are from primary schools, 84 are from middle schools, and 82 are from high schools (Figure 16).



Answer Choices	Responses	
Primary school	31.40%	76
Middle school	34.71%	84
High school	33.88%	82
Total		242

Figure 16. Teacher respondents' distribution in different level of schools

Among all the respondents, there are 136 female teachers and 106 male teachers (Figure 17).

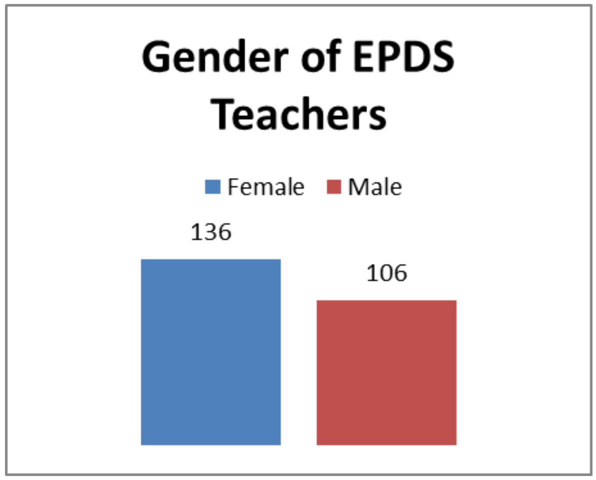


Figure 17. Gender fact of teachers

The average age of respondents is 39. The largest portion (48.76%) of teachers falls into the 31–40-year-old age level (Figure 18). Nearly 70% of the teachers had received an undergraduate degree or more as their highest level of education . Approximately 27% of the teachers received a senior teacher's college degree (Figure 19). This degree distribution generally meets the expectations for teacher's education level in Ya'an (EMAY, 2013).

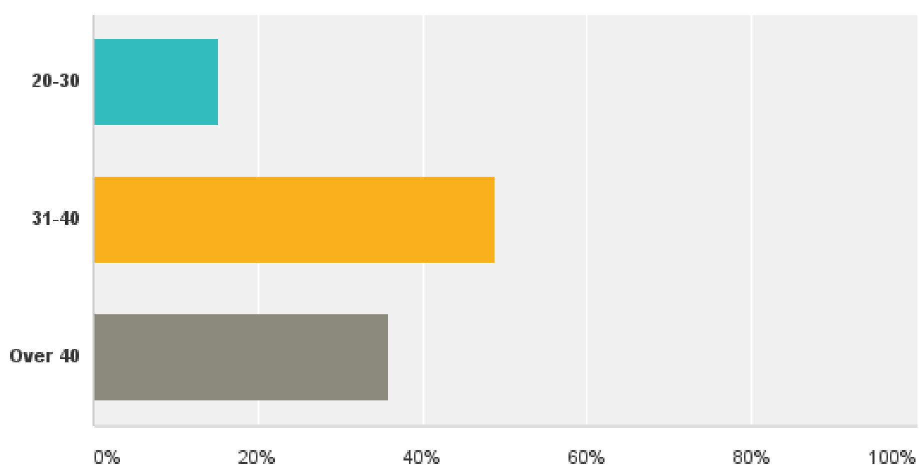
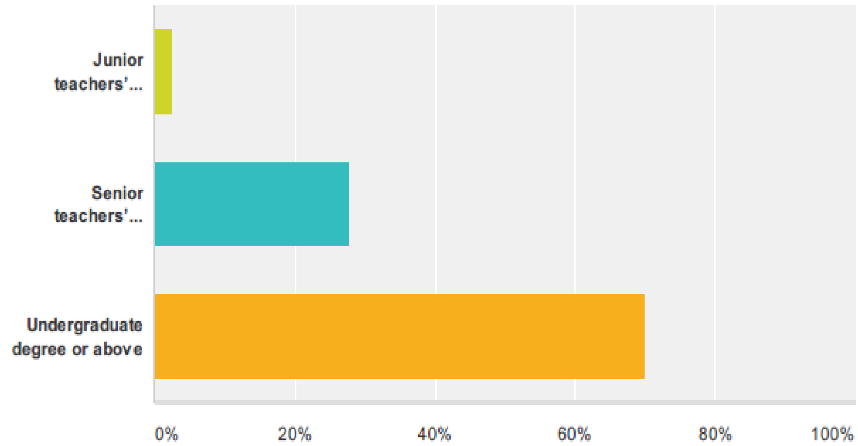


Figure 18. Age fact of teachers



Answer Choices	Responses	
Junior teachers' school	2.48%	6
Senior teachers' college	27.69%	67
Undergraduate degree or above	69.83%	169
Total		**242**

Figure 19. Highest education teacher completed

4.2.1 Findings: What did the EPDS teachers say they did for preparation and response pre, during, and after the 2013 Lushan Earthquake?

Attitude toward earthquake preparation

Following the procedure outlined in the methodology chapter, this research uses scores to describe teachers' attitudes toward earthquake preparation/training and best practice for response to earthquake.

The scores of attitude retrieved from survey questions five, six and seven for teacher's opinions towards earthquake, each answer is marked with scores due to their weight either by category (from less important/possible to every important/possible), or evenly scored for multiple answer-selected question. These questions are as follows (The number behind answers are the scores, and scores dropped "others" option):

2. *In your opinion, how often do earthquakes occur in your region?*
    a. *Never--0*
    b. *Rarely possible--1*
    c. *Possible--2*
    d. *Highly possible--3*
3. *In your opinion, how important was earthquake preparation/education in the primary/secondary school where you were teaching?*
    a. *Very important--3*
    b. *Important--2*
    c. *Normal--1*
    d. *Not important--0*
4. *Which of the following options inspired (or drove) you to participate in earthquake preparation/training in your school (you can choose multiple answers)?*
    a. *I just did the best I could for the safety of my students--1*
    b. *Following policies from authorities or school administrations seemed to be enough--1*
    c. *I just want to help--1*

d. I now think I need to know even more about earthquake surviving skills and knowledge than what is currently required because I think my students need it--1

The sum of all selected answer is the attitude score. Out of a total possible score of 10, the attitude factor of the respondents falls into a normal distribution with a mean of 6.66 and standard deviation of 1.233 (Figure 20).

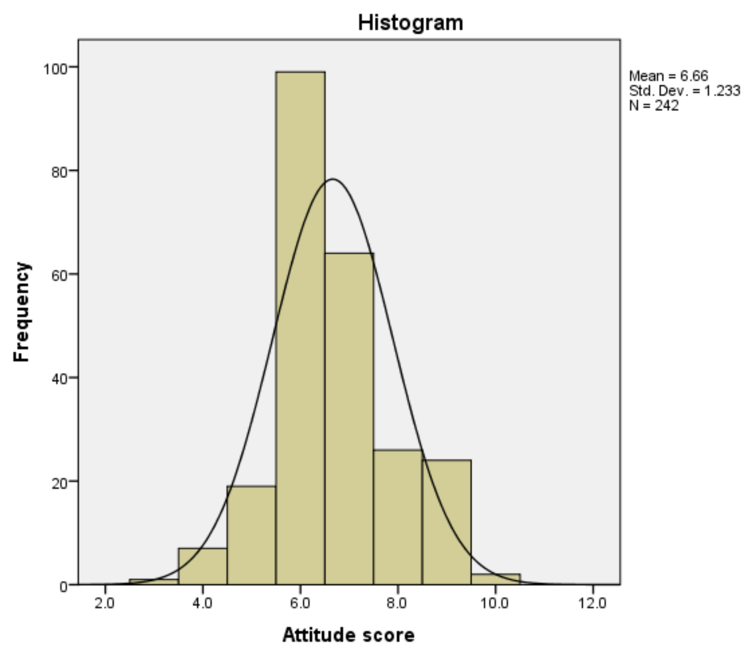
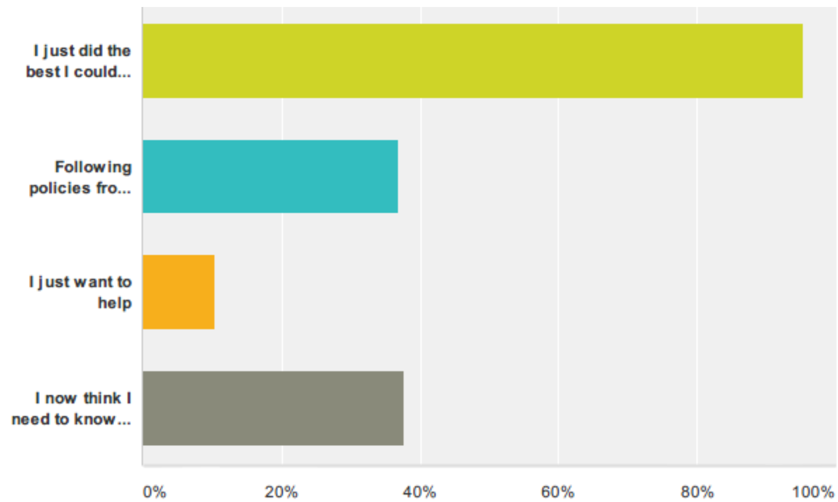


Figure 20. Attitude score histogram with normal curve

Of the teacher respondents, 70.95% answered that they thought it was possible to have an earthquake in their city before they experienced the Lushan Earthquake. That is not a surprising result, since these teachers live in an earthquake-prone region. What is more surprising is that, before the Lushan Earthquake, more than 10% of teachers believed that the probability of having an earthquake is very low, or even impossible. In addition, before the earthquake, the EPDS teachers almost unanimously believed that training/preparation activities are important (99%). Most of the teachers thought the incentive (Figure 21) to perform EPDS training is their responsibility for students' lives (95.45%), and some of them think that they want to learn more than what EPDS requires to protect students (37.6%). Following authorities' orders is also another incentive (36.78%) driving teachers to practice training.



Answer Choices	Responses
I just did the best I could for the safety of my students	95.45% 231
Following policies from authorities or school administrations seemed to be enough	36.78% 89
I just want to help	10.33% 25
I now think I need to know even more about earthquake surviving skills and knowledge than what is currently required because I think my students need it	37.60% 91
Total Respondents: 242	

Figure 21. Teachers' incentive to participate in preparation

Preparation/training score

As we discussed in the methodology chapter, the preparation scores are summed from the score-designed answers of teachers' preparation activities, and thereby this score represent respondents' cumulative facts of preparation. These questions includes survey question 11, 12, 13, 14, 15 and 16 (see appendices for detail). Each question answer is marked with scores due to their weight either by category (from less important/possible to every important/possible), or evenly scored for multiple answer-selected question.

The result shows that the score also falls into a normal distribution (Figure 22), with a mean of 21.34 (total is 37) and a standard deviation of 5.73. The percentage of the mean score divided by total score is 57.67%, which indicates teachers finished more than half of the required preparation procedures (based on different weights given to different procedures). Before revealing the result, I thought the preparation score would be higher, because such EPDS policies are adopted by all EPDSs, and the schools should follow all the details for practice, such as all kinds of knowledge trainings, preparing students' emergency contacts, drills and other practices. There is no significant result that specific areas (counties) or levels of schools have extremely high or low scores.

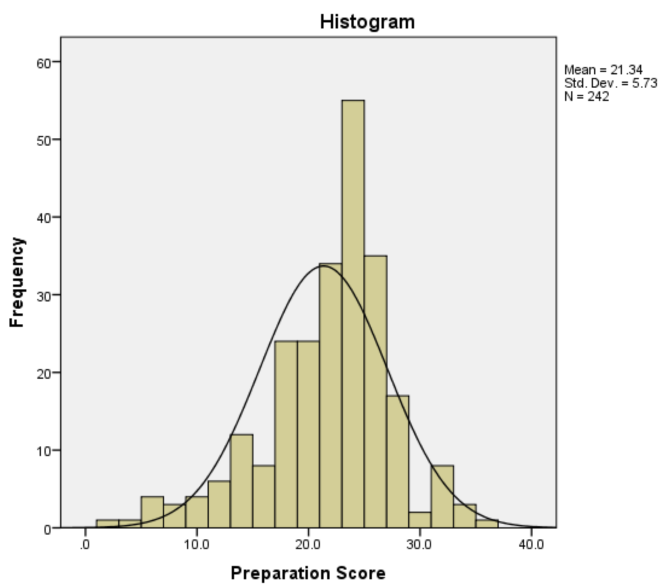


Figure 22. Preparation score histogram and normal curve

The survey shows that, most of the teachers received some kind of knowledge training to prepare them for earthquakes; the majority of the approach is conducted through self-learning (66.22%). The participation for the organized EPDS knowledge training process is not high (Figure 23).

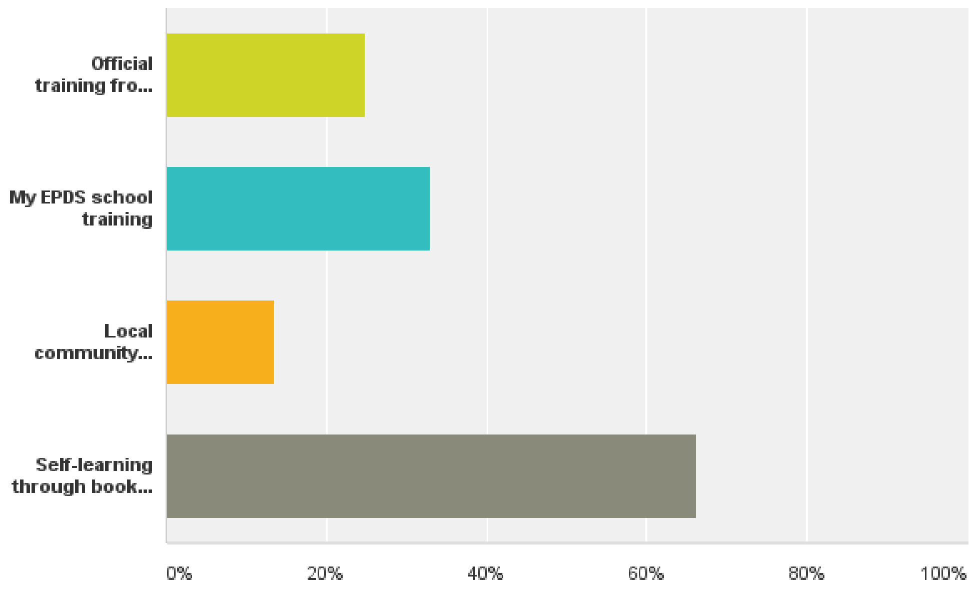
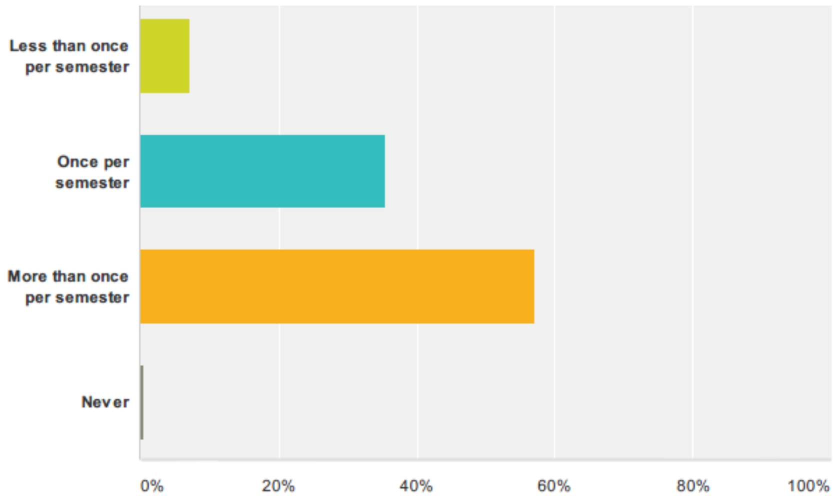


Figure 23. Teachers' knowledge traning approaches

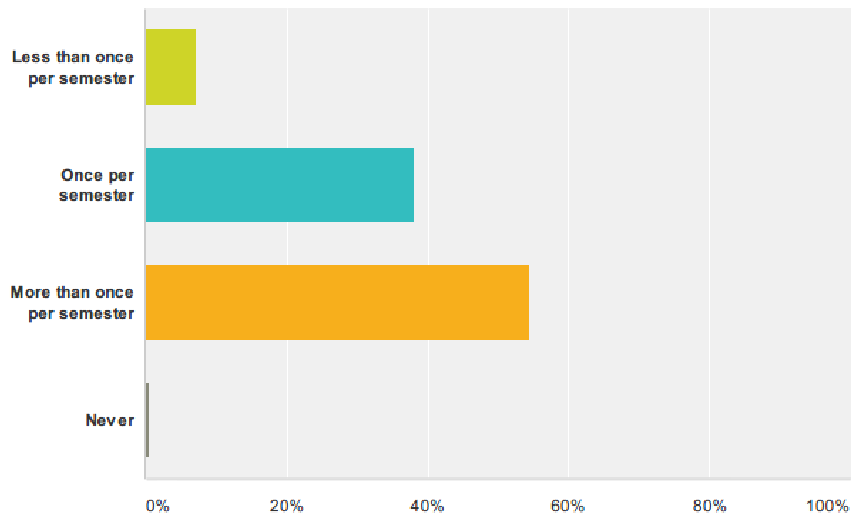
Although the knowledge training score shows less impressive results, the teachers' understanding of the emergency plan and following of drill practice looks positive. Teachers predominately believe they know the emergency response plan (93.75%). Furthermore, 34.93% of teachers know the plan well and regularly practice it, while 48.03% of teachers occasionally practice the plan with a good understanding of the content. In addition, many teachers give lessons to students on earthquake preparation. More than 89% of teachers conduct such lessons at least once per semester, or even more often (Figure 24).



Answer Choices	Responses	
Less than once per semester	7.02%	17
Once per semester	35.54%	86
More than once per semester	57.02%	138
Never	0.41%	1
Total		242

Figure 24. Frequency of teacher conducting knowledge training to students

The frequency of evacuation drill conduction is also satisfactory. Of all teacher respondents, 54.55% practice drills more than once per semester and 38.02% participate once per semester (Figure 25).

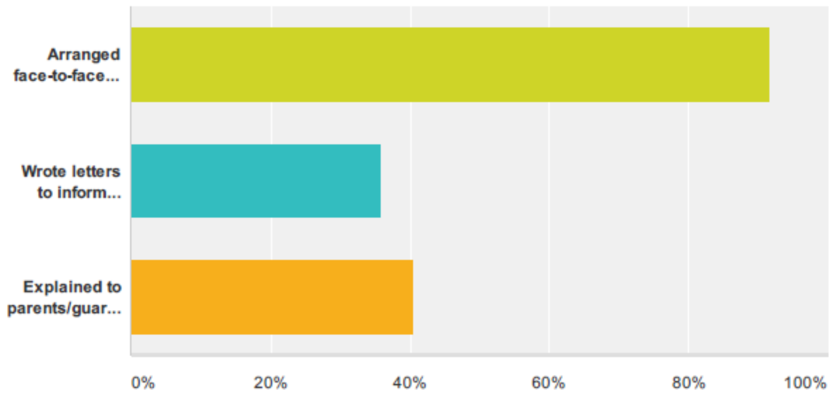


Answer Choices	Responses	
Less than once per semester	**7.02%**	17
Once per semester	**38.02%**	92
More than once per semester	**54.55%**	132
Never	**0.41%**	1
Total		**242**

Figure 25. Frequency of teachers participating in evacuation drills

Concerning all the drills in which teachers participated, 54.77% of teachers used to receive a surprise drill without pre-notice to them and the students. Such a drill practice may bring a better effect than normal drill with pre-notice (EMAY, 2013). In addition, 13.28% of teachers used to participate in drills with students' parents and guardians. Drills including parents and guardians do not necessarily seek to integrate parents into evacuation procedures, but rather help parents to better understand the school's efforts to protect their children and to learn where to find their children when an earthquake happens.

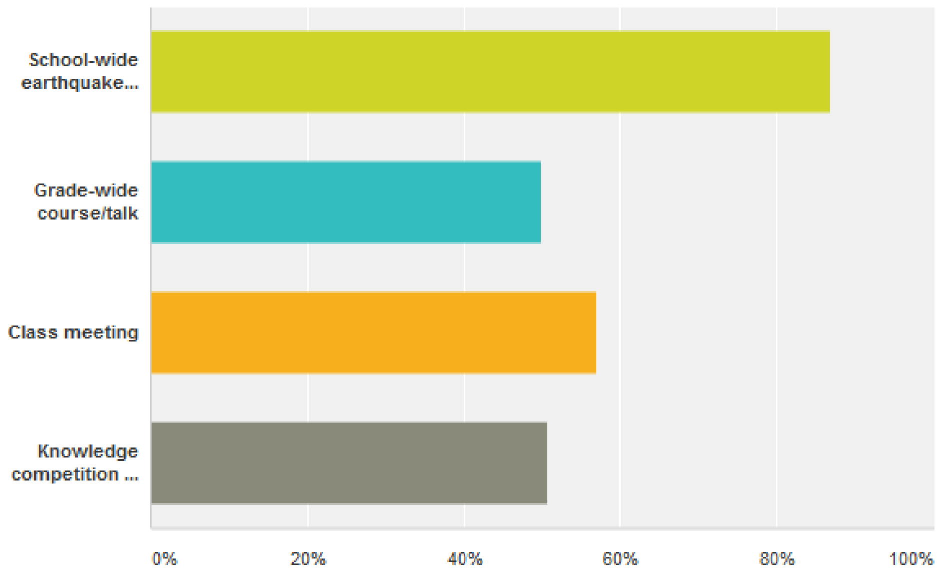
The EPDS policy requires teachers to utilize multiple ways to inform parents and guardians of their preparation activities. Our survey asked teachers about three major communication options: face-to-face meetings, letters to parents, and phone calls or phone text messages. Of teacher respondents, 91.74% have conducted face-to-face meetings with parents to discuss earthquake preparation, while more than a third of the respondents had used the other two (Graph 26).



Answer Choices	Responses	
Arranged face-to-face meetings with teacher and parents/guardians	91.74%	222
Wrote letters to inform parents/guardians	35.95%	87
Explained to parents/guardians by phone/text	40.50%	98
Total Respondents: 242		

Figure 26. Teachers' approaches to inform parents

During the preparation phase, the drill practice and knowledge lessons for students have been implemented well by teachers due to high participation in drills, student-learning sessions conducted (Figure 27), and emergency plan learning. The knowledge learning and training (or theory learning) for teachers have been relatively less developed, since teachers need to adopt self-learning process without standard guidance during an organized training activities from authorities, schools or community. The survey reveals that EPDS teachers are focusing more on actual practice than on theory learning.



Answer Choices	Responses	
School-wide earthquake knowledge/safety course/talk	86.78%	210
Grade-wide course/talk	50%	121
Class meeting	57.02%	138
Knowledge competition or talent show with topic of earthquake preparation (drawing, writing, etc.)	50.83%	123
Total Respondents: 242		

Figure 27. Fact on different approaches of knowledge training for students

<u>Best practice score</u>

The research defines best practice as effective teacher responses (implementing proper EPDS training procedures) during and after an earthquake. The sum of scores of effective actions resulted in the best practice score. These questions include survey questions of 24, 25 26, 27, 29 and 30. The answers for questions are equally weighted, and each question counted for score from 2 to 7 due to the number of choices.

The full best practice score is 27, and the average score per teacher is 14.92, with a standard deviation of 3.917 (figure 28). The mean divided by the full score is 62.17%. This indicates that EPDS teachers can, on average, fulfill more than 60% of the designed procedures emergency response. There is no significant result that specific areas (counties) or levels of schools have extremely high or low scores.

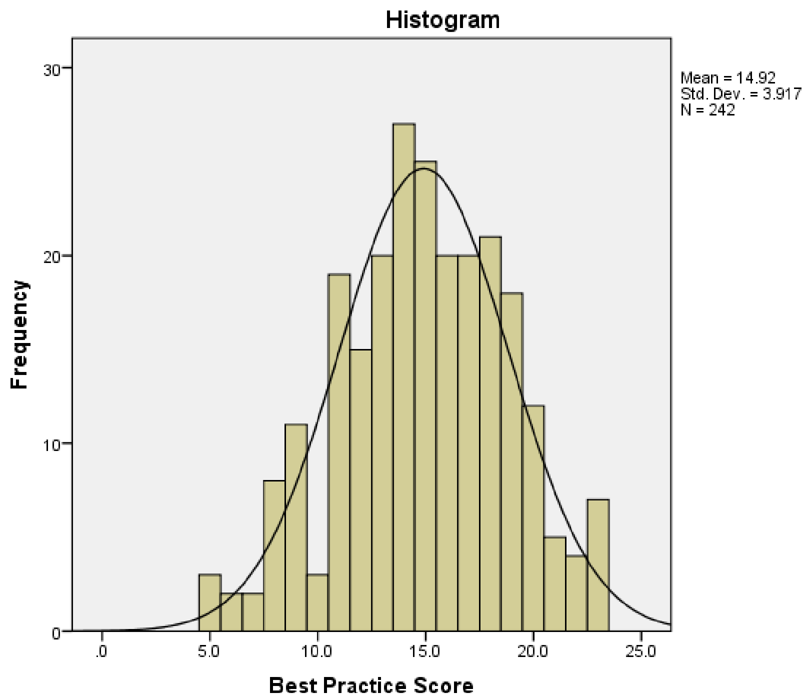
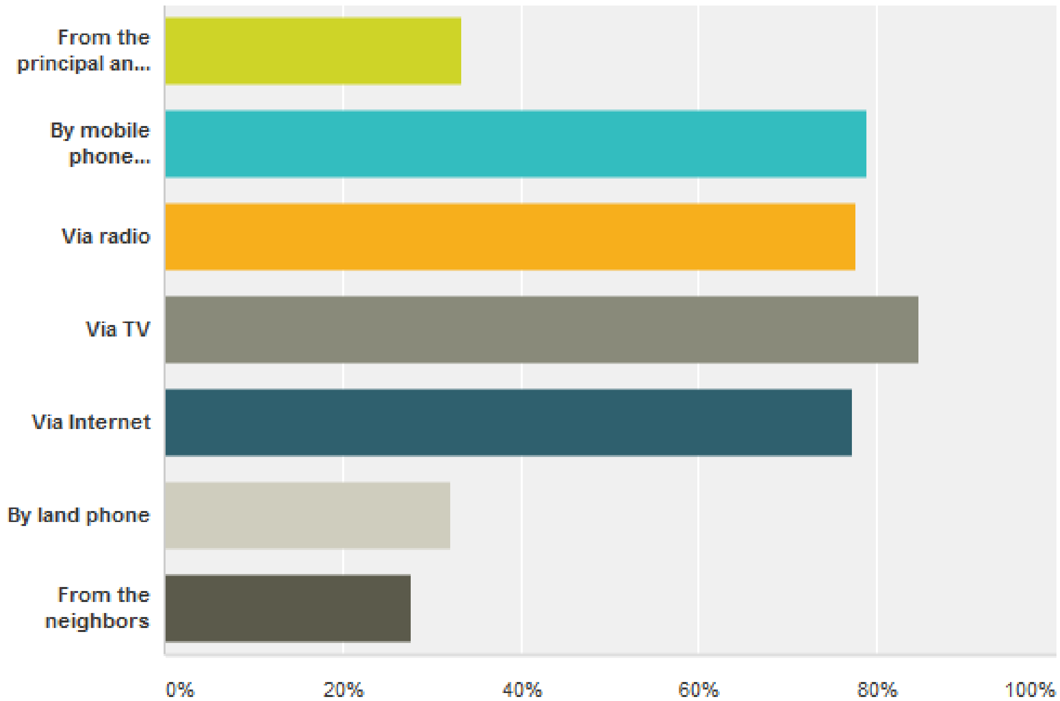


Figure 28. Best practice score histogram and normal curve

More than 70% of teachers asked students to hide under a table or evacuate the building. Many procedures were taken after the tremor passed, such as conducting roll call and safety check on students, keeping students organized, and appeasing panicked students. More than 40% percent of teachers chose to look for earthquake information or news. Such actions may help teachers better know the disaster situation and convey information to students in order to avoid rumors and the resulting chaos.

Among several approaches to collecting earthquake news, the four major ways by which teacher chose to access information were mobile phone/text message, radio, TV, and the Internet (Figure 29) Although many mobile phone signal towers were dysfunctional during the first couple of hours, text messaging proved to be an effective means of communication. The mobile 3G network may have helped such communication due to the Weixin app, which is a texting app that requires only a small amount of data and has very good transmission stability. The cable TV and internet options were still robust after the quake, and conveyed information effectively.



Answer Choices	Responses	
From the principal and other teachers	33.47%	81
By mobile phone (including text message and texting apps, etc.)	78.93%	191
Via radio	77.69%	188
Via TV	84.71%	205
Via Internet	77.27%	187
By land phone	32.23%	78
From the neighbors	27.69%	67

Figure 29. Teachers' approaches to acquire earthquake information

More than 85% of teachers evacuated students to an evacuation area that was approved by EPDSs or another authority, and none of them kept students inside the building after the earthquake. Of the teacher respondents, 86.5% know how many students were evacuated. More than 90% of teachers confirmed the students' safety on the day the earthquake struck.

To summarize, most respondents took many proper procedures (or followed best practice) to help save students' lives. The survey indicates that EPDS teachers immediately asked students to hide or evacuate, and then helped to keep the students safe and calm while collecting earthquake information. They thus responded well.

4.2.2 Findings: What training did EPDS teachers think worked best for them?

The survey also asked respondents to reflect on what training/preparation activities they believed worked best. Many procedures were selected (Figure 30). The top five selected procedures are: surprise drill, face-to-face meetings with parents, general EPDS training, learning the emergency plan, and self-learning to achieve earthquake knowledge and response skills.

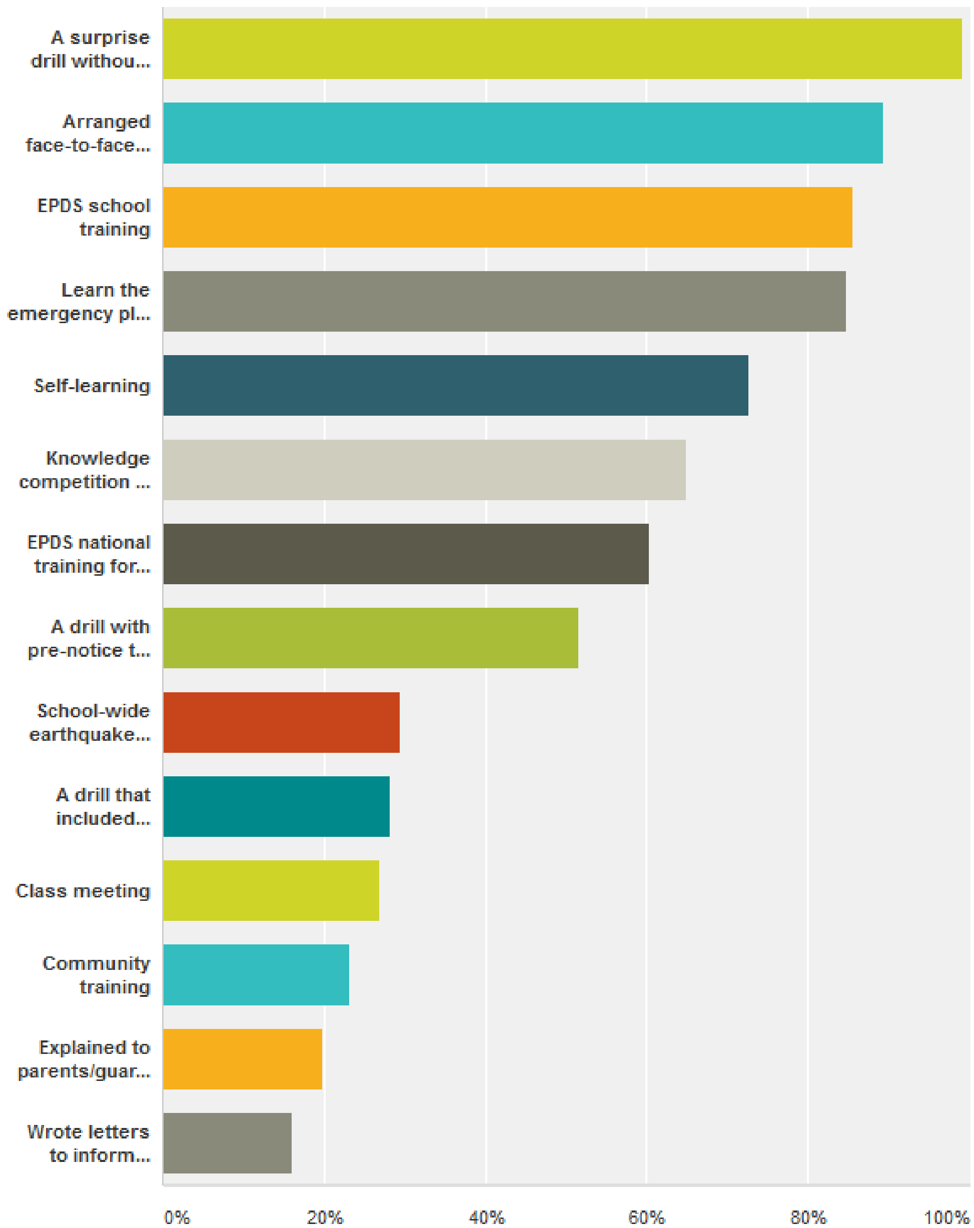


Figure 30. Teachers' reflection on what methods worked best for preparation

It is not surprising that drills and face-to-face meetings are the top two choices, since many respondents selected them in the preparation section of the survey. EPDS training and emergency plan learning are also expected to be welcomed procedures. It is most interesting that many teachers believe self-learning worked best for preparation. This self-learning process represents learning from non-EPDS designated information sources (textbooks or training sessions), such as internet, video and books. Considering the preparation score (average 21.34 of 37, not very high score), and the relatively high practice participation vs. low theory learning, I believe that many teachers acquire knowledge of earthquake and protection skills on their own time. Though the self-learning is an informal way comparing to EPDS official training, teachers believed that such self-learning process is useful for survive. I think that is because teachers may flexibly take available time for such session, and will not use regular class time like EPDS official training would do. In current exam-oriented system, the priority of regular class time is students' exam preparation, and thereby training without taking much of such time may become a good choice.

Interesting findings from the open-minded reflection question:

At the end of the survey, there is an open-minded question asking teachers about reflections on EPDS training and earthquake experience. There were 19 teachers answered the open-ended question about their reflections. Though the number is small comparing to 242 total respondents, the ideas they contribute is crucial. The most frequently referenced answer is an assertion that providing psychological assistance to students is crucial. This assistance includes the assistance for pre, during or after the earthquake, and teachers thought they should receive such training to help students. Five respondents thought that effective psychological help might keep students calm and brave in the face of an earthquake and its consequence.

In addition, respondents provided several suggestions to improve evacuation quality. One teacher thought the building should have more emergency exits, that the evacuation route should be wider, and that the height of each staircase of the route should be less. These tips stem from the respondent's field experience. Lowering the staircase may help reduce the possibility that students will fall down during evacuation. Another respondent also talked about improved evacuation route quality, stating that the routes should have fewer corners and narrow paths, and that the distance from classrooms to open fields should be shorter.

One interesting reflection was that umbrellas set outside the classrooms could block the route. Ya'an city is famous for its long rainy season. Students and teachers bring umbrellas to school every day for months. Usually, umbrellas are put next to the wall outside the classrooms, and are kept open to allow them to dry. If an earthquake happened in the rainy season, these umbrellas may possibly block the route and cause chaos. Though only one teacher contributed to this point, and such issue needs further analysis, I still believe this reflection is a critical issue that needs to be considered.

4.2.3 A multivariate regression analysis that explores the relationships between EPDS training and best practice

This section of the research explored the relationships between the EPDS training/preparation score and the best practice score. Several other factors will be considered as well, including teacher gender, age, highest level of education received, and attitude score.

As the methodology chapter demonstrated, I intend to explore the relationships between the best practice score and the preparation score, and the other factors should be considered as well. Therefore, I have a dependent variable Y as best practice score, and all other factors are potential predictive variables Xs (independent variables). The equation shows the basic formation of the multivariate regression analysis. The idea is to predict Y through multiple Xs.

The coefficient β represents the effects of predicted variable X to Y, β_0 represents a constant variable in the equation, and ε represents the error term (which can be controlled during the analysis).

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots \beta_p X_{ip} + \varepsilon_i, \qquad i = 1, 2, 3 \ldots n, \ldots$$

Figure 31. Linear regression equation

Now we have five potential predicted variables (let us call them candidates), training/preparation score, gender, age, highest level of education received, and attitude score. Which of them should I put into the equation? I have no idea which candidates or candidates' combination have significant correlations with Y, or how the candidates within the combinations may affect each other so that they may become insignificant and useless to regression. Therefore, we need to adopt a way to choose "good" (significant correlated with Y) candidates.

To find the "good" candidates, the research utilized a multiple linear regression analysis through the stepwise regression. Stepwise regression is an approach to regress multiple variables while simultaneously removing insignificant variables. In statistics, stepwise regression includes regression models in which the choice of candidates is carried out by an automatic procedure (Hocking, 1976). This procedure for model selection in cases where there are a number of candidates, and no underlying theory on which to base the model selection (candidates selection). The procedure starts with no variables in the model, testing the addition of each variable using a chosen model comparison criterion (F-test for correlation in our case), then put the candidates into the model for regression analysis based on its correlation with Y. The regression analysis itself has no difference from other linear regression. The only difference in stepwise regression is that it provides an approach to choose “good” independent variables.

To sum up, the stepwise regression essentially performs a multiple regression analysis a number of times, each time removing the weakest correlated variable. At the end, the model will produce the variables that explain the distribution best.

The only requirements for variables are that they must be normal distributed, and have no collinearity among independent variables. Figure 32-35 shows that all nominal variables we will use (both Y and Xs) are normally distributed.

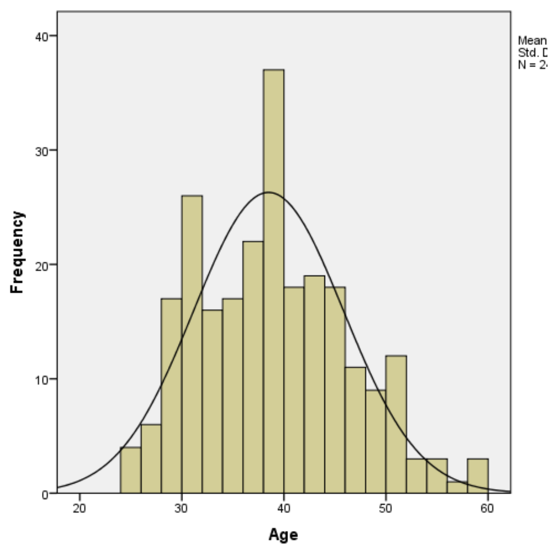


Figure 32. Age histogram and normal curve

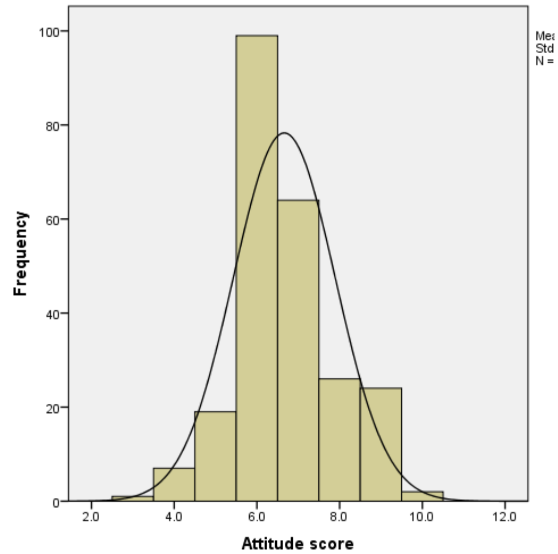


Figure 33. Attitude score histogram and normal curve

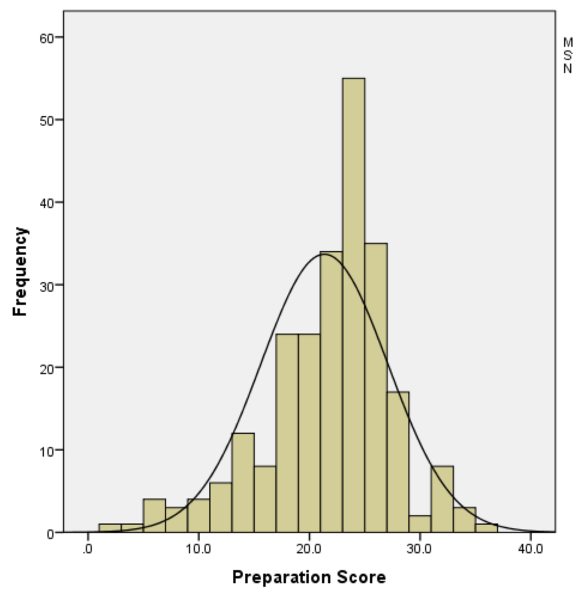


Figure 34. Preparation score histogram and normal curve

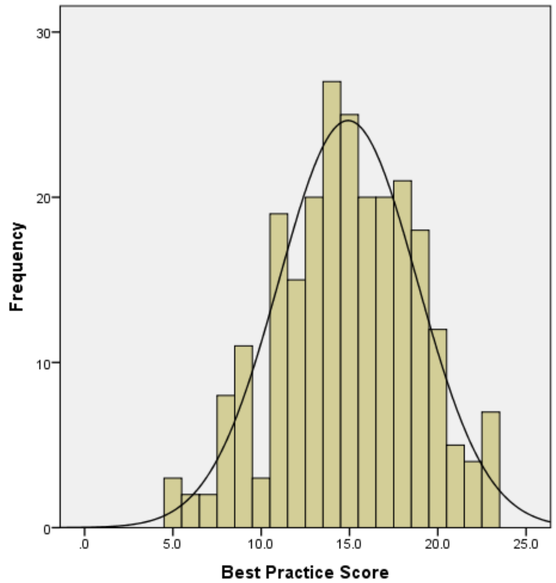


Figure 35. Best practice score histogram and normal curve

In addition, there are two candidates: gender (called female in our case, and I will explain) and education as dichotomous variables. Dichotomous variable is categorical variables with two levels. In our case, gender, now called female has value of 1 representing the teacher is female, and 0 the male. Since the value 1 represents female, gender variable now is called female. Education has value of 1 representing the teacher received undergraduate or higher as their final degree, and 0 as other lower degrees. The reason to recode Education into the dichotomous variable is that predominantly the survey answer of education is undergraduate degree or above, only small portion of answers are other lower degrees. Therefore, I would like to see if undergraduate or above degree has influence on best practice.

Dichotomous variables can be directly entered as independent variables in a multiple regression model (Stockburger, 1998). Their use in multiple regression is a straight forward extension of their use in simple linear regression. In a regression model, dichotomous variable can be considered as constant variables in two linear models. In a model with variable=1, then the model has another constant variable other than β_0, and when the variable=0, then we have another model with this constant variable as 0 (which means you do not have this variable in the model at all). These two models have all other same variables, and the only difference is this two values. Therefore, the coefficient of a dichotomous variable represents the different effect between value 1 and 0.

Now we know, in our case female and education can be input into regression. We also need to test the collinearity among independent variables. It will be shown in the following result. In addition, a test for heteroskedasticity will also be conducted.

After running a correlation matrix (Table 16) and several regressions, the analysis selected two independent variables—preparation score and female—to have significant effects to the dependent variable of best practice score (see table 17). In addition, there is no significant correlation between preparation score and female (F-test shows value of 0.153, the significant value should less than 0.05). Other variables are excluded due to their lack of significance.

Table 16. Correlation Matrix with significance test for dependent and independent variables

Correlations

		Best Practice Score	Female	Age	Education
Pearson Correlation	Best Practice Score	1.000	.165	-.066	-.044
	Female	.165	1.000	-.291	-.145
	Age	-.066	-.291	1.000	-.240
	Education	-.044	-.145	-.240	1.000
	Attitude score	.178	.028	-.013	.134
	Preparation Score	.821	.066	-.043	-.049
Sig. (1-tailed)	Best Practice Score	.	.005	.152	.249
	Female	**.005**	.	.000	.012
	Age	.152	.000	.	.000
	Education	.249	.012	.000	.
	Attitude score	.003	.334	.422	.019
	Preparation Score	**.000**	**.153**	.251	.225
N	Best Practice Score	242	242	242	242
	Female	242	242	242	242
	Age	242	242	242	242
	Education	242	242	242	242
	Attitude score	242	242	242	242
	Preparation Score	242	242	242	242

Table 17. The selected two variables with their p-value range

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Preparation Score	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Female	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Best Practice Score

The following table 18 shows that the model with female (female as 1, male as 0) and preparation score can explain 68.4% of the dataset (adjusted R Square in model 2), which is a very positive result. The Durbin-Watson figure is 1.665 > 1.5, which indicates that there are no meaningful serial correlations in residual (this is reasonable since our dataset is not a time-series data)

Table 18. Model summary with R-squre

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.821[a]	.674	.673	2.2406	
2	.829[b]	.686	**.684**	2.2027	1.665

a. Predictors: (Constant), Preparation Score

b. Predictors: (Constant), Preparation Score, Female

c. Dependent Variable: Best Practice Score

The ANOVA table (table 19) indicates that our regression model with female and preparation score is significant (model 2), which means there exists linear relationships between dependent variable (best practice score) and independent variables.

Table 19. ANOVA result for model with preparation score and female as the independent variables

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2,493.527	1	2,493.527	496.710	.000[b]
	Residual	1,204.820	240	5.020		
	Total	3,698.347	241			
2	Regression	2,538.730	2	1,269.365	261.619	.000[c]
	Residual	1,159.617	239	4.852		
	Total	3,698.347	241			

a. Dependent Variable: Best Practice Score

b. Predictors: (Constant), Preparation Score

c. Predictors: (Constant), Preparation Score, Female

At the beginning the section, we pointed out that we need to exclude collinearity of all input independent variables, including both used and dropped variables. The following table 20 shows that all excluded variables have more than 90% of tolerance. Tolerance is an indication of the percent of variance in the independent variables that cannot be accounted for by the other independent variables, and thereby high value of tolerance can exclude the collinearity among independent variables (X. Chen, Ender, Mitchell, & Wells, 2003). The following table shows that even our excluded candidates meet the requirement of no significant collinearity. The chosen candidates: preparation score and female also have high tolerance, which will be shown later. **Therefore, all candidates meet the requirement for stepwise regression**.

Table 20. Excluded variables with their collinearity test

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Female	.111[b]	3.052	.003	.194	.996	1.004	.996
	Age	-.031[b]	-.835	.404	-.054	.998	1.002	.998
	Education	-.004[b]	-.103	.918	-.007	.998	1.002	.998
	Attitude score	-.008[b]	-.201	.841	-.013	.949	1.054	.949
2	Age	.001[c]	.033	.974	.002	.915	1.093	.913
	Education	.012[c]	.331	.741	.021	.978	1.023	.976
	Attitude score	-.009[c]	-.244	.807	-.016	.949	1.054	.945

a. Dependent Variable: Best Practice Score

b. Predictors in the Model: (Constant), Preparation Score

c. Predictors in the Model: (Constant), Preparation Score, Female

The following table 21 shows how the two independent variables affect the best practice score.

1. Both preparation score and female have high toleration regarding to collinearity, which assures the correctness of using this model.
2. Both independent variables have a significant relationship with best practice score. The preparation is more significant (p-value < 0.0001 while significance level of p-value should be smaller then 0.05) than female (p-value = 0.03 < 0.05).
3. Given the same preparation score, female has 0.111 better practice score than male on average. Since the total score of best practice is 27, such a difference is 0.41%. It is not a huge difference, yet it is significant.
4. **Fourth and most important**, among scores received by teacher respondents of the same gender, every one score increase in preparation increased the best practice score by 0.814. That is an increment of 3% of best practice. This indicates the preparation indeed positively affects best practice. Thus, every 2.7% increase in preparation score will increase the best practice score by 3%. If we give a ratio as increment between preparation and best practice score (best practice score divided by preparation score: 3/2.7), the ratio is 1.11, which means every 1% effort increment of preparation can give 1.11% increment in best practice. This is both a significant and positive result.

Table 21. Regression resulte for the model with preparation score and female as independent variables

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.936	.557		5.275	.000	1.840	4.032					
	Preparation Score	.561	.025	.821	22.287	.000	.512	.611	.821	.821	.821	1.000	1.000
2	(Constant)	2.552	.561		4.546	.000	1.446	3.658					
	Preparation Score	.556	.025	.814	22.419	.000	.507	.605	.821	.823	.812	.996	1.004
	Female	.873	.286	.111	3.052	.003	.310	1.436	.165	.194	.111	.996	1.004

a. Dependent Variable: Best Practice Score

Test for excluding heteroskedasticity

The aforementioned linear regression model assumes that the variance of residual (error term) remains the same. This is a phenomenon known as homoscedasticity. If the variance violates this assumption, it is known as heteroskedasticity, which leads to biased standard error and damages the model.

The following figures 36 and 37 provide basic information about the residual. The regression standardized residual is normally distributed, and it follows a line in a normal P-P plot. The scatterplot (Figure 38) also shows a condensed distribution between residual and predicted value. All these non-statistical observations indicate that our regression model remains homoscedastic.

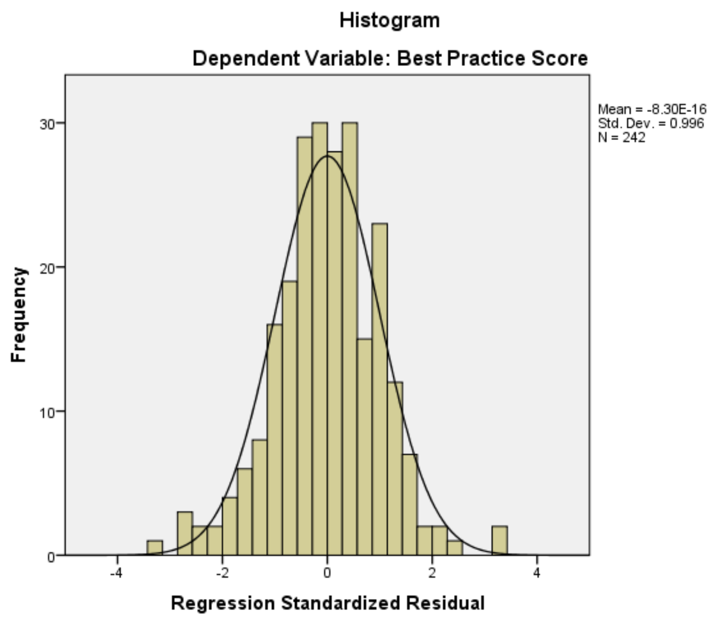


Figure 36. Regression standardized residual histogram and normal curve

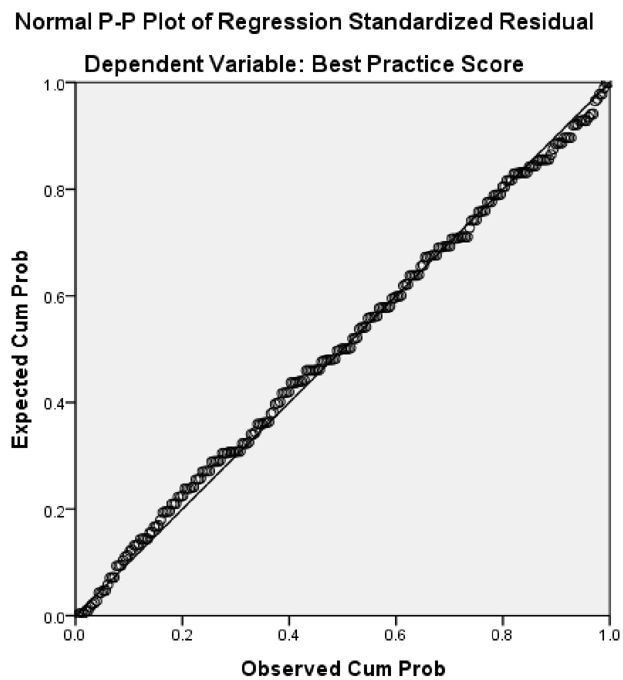


Figure 37. P-P plot graph

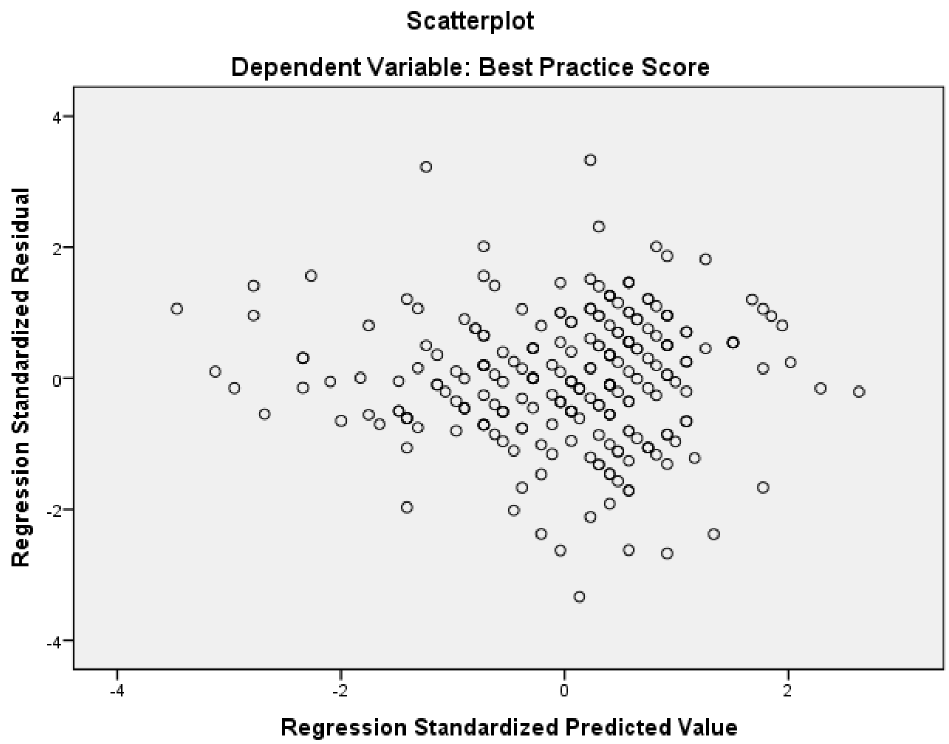


Figure 38. Scatterplot for regression standardized residual vs. regression standardized predicted value

Other than non-statistical observation, the research utilized both the Breusch-Pagan test and Koenker test for heteroscedasticity. The Breusch-Pagen test (named after Trevor Breusch and Adrian Pagan) is used to test for heteroscedasticity in a linear regression model (Breusch & Pagan, 1979). It tests if the estimated variance of the residuals (error term) from a regression are dependent on the values of the independent variables. Koenker test also serves the similar purpose without high sensitivity on normality (Koenker & Bassett, 1982).

The result (Figure 39) of two tests shows that there is no sign that the model falls into heteroscedasticity. Both null hypotheses (homoscedasticity) cannot be rejected based on the 95% confidence interval ($p < 0.05$). The Breusch-Pagan test has a 0.1274 p-value, and the Koenker has a 0.2341 p-value. Both values are not significant enough to reject the null (homoscedasticity).

```
Breusch-Pagan test for Heteroscedasticity (CHI-SQUARE df=P)
    4.120

Significance level of Chi-square df=P (H0:homoscedasticity)
    .1274

Koenker test for Heteroscedasticity (CHI-SQUARE df=P)
    2.904

Significance level of Chi-square df=P (H0:homoscedasticity)
    .2341
```

Figure 39. Test result for heteroscedasticity

Through regression analysis, the preparation score was found to significantly affect the best practice training score. Given female controlled, every 2.7% increment in preparation score will increase the best practice score by 3%. Another interesting finding is that the gender also significantly affects the practice. Females have slightly better practice scores than males.

4.3 THE COMPARISON BETWEEN POLICY EXPECTATION AND ACTUAL IMPLEMENTATION

The aforementioned analysis indicates that EPDS teachers generally meet the expectations from policy makers. The EPDS policy aims to allow teachers to both theoretically and practically prepare themselves and students against earthquakes. EPDS teachers indeed actively participate in many kinds of practice, including drills and knowledge lessons to students. They also inform parents of the process of their preparation, as outlined in EPDS policy. The 2013 earthquake showed that teachers effectively utilized the skills they learned to protect students, and the zero-death result indicates that such preparation provides some meaningful protection of students.

The EPDS policy also emphasizes the building’s survivability against earthquake. As the previous section explained, there was no building collapse or severe damage. Although building survivability is not the responsibility of teachers, good building quality is the very base for teachers to conduct effective evacuation procedures and saving lives.

In Lushan Earthquake, the intensity scale in the epicenter of the earthquake is level 9, and the peripheral region experienced less intensive damage (Sciencenet.cn, 2013). The average required EPDS building quality is survive through intensity 8-9 level earthquake, and the policy also points out even the intensity scale surpasses the building survivability, the building should as much as possible to avoid total collapse (EMAY, 2013; Sciencenet.cn, 2013). The non-EPDS schools just follow the local intensity scale standard as level 7(Sciencenet.cn, 2013), and thereby the EPDS buildings have better chance survive large earthquakes. Though, I do not have information on the building damage of non-EPDS in Ya’an during Lushan Earthquake, the EPDS buildings indeed showed a good quality to survive the tremor (pictures in policy expectations shows the slight damage of EPDS school buildings).

The teacher respondents also believe that several major EPDS preparation activities are crucial, including surprise drills and learning the emergency plan. In addition, they provided innovative thinking on how to increase students’ capacity against earthquakes by learning how to give students psychological assistance during training and after the earthquake and improving the quality of evacuation routes. The umbrella issue is interesting, and demonstrated that teachers keep a high alertness when it comes to school safety, and use critical thinking to help improve every possible detail to protect students.

The regression analysis also strengthens the idea that EPDS preparation helps improve teachers' response during and after an earthquake. The female teacher respondents' slight advantage on practice may be due to the additional carefulness of primary school teachers, who were predominantly female. It might also be asked if such an advantage is based on gender-based cultural differences. Further analysis is needed to determine a more thorough explanation of this finding.

The research also finds that EPDSs and teachers did not strictly follow the rules of knowledge training for teachers. Many teachers utilized self-learning as the approach to gain knowledge about earthquakes, and then taught students based on such knowledge. EPDS policy clearly indicates that schools, authorities, and local communities should play a major role in conveying earthquake-related information and knowledge to teachers. In the policy expectation section, I stated that EPDS policy required teachers to participate in workshops or curriculums about earthquake mitigations. These sessions should be arranged by many kinds of authorities, including earthquake agencies, NGOs, and academic organizations. For example, EMAY arranges earthquake safety workshops at the beginning of every semester, and teachers are required to participate (EMAY, 2013). Our survey shows self-learning is a major way of such training, which indicates this piece of EPDS expectation does not implement very well.

5.0 POLICY RECOMMENDATIONS AND CONCLUSION

This research conducted a comparative analysis among Earthquake Preparation Demonstration Schools' (EPDSs') policy expectations and teacher's practices and reflections. A linear regression analysis tested the relationship between preparation and response during the case of the 2013 Lushan Earthquake. The result shows that, despite the fact that some preparations were not implemented well, such as earthquake knowledge training from organizations (self-learning as a major way instead), the teachers' implementation of these policies generally met the expectations of EPDS policy makers. The regression analysis also indicates that EPDS preparation played a significant role in affecting the earthquake response activities.

As previous chapters illustrate, different countries and organizations have different policies and designs for disaster education. Some are more policy-focused (U.S.A), and some are practice-focused (e.g. Japan). In the U.S., though various standards, policies and framework were developed as national government effort, training tends to form around individual school or school district's decision. The frequency of conducting training does not follow a required rule from central agencies. On the contrary, in Japan, national policies can require the frequency of the practice to schools due to a centralized government system.

The current EPDS policy and implementation reveals a highly practice-focused framework on earthquake preparation. Chinese policy makers and practitioners believe that routine practice is an effective way to reduce human loss during an earthquake. Now there is growing evidence to support that, and this research provides positive evidence as well. Compared to earthquake prediction research, earthquake preparation is still limited in its capacities to expand to more schools. It is hoped that the success of EPDS cases in events such as the effective and brave response of Ya'an teachers in the Lushan Earthquake may help draw crucial attention to this program and stimulate its application across all schools in China.

In the public policy and management domain, there are many issues considered to be wicked problems. The EPDS policy and its information sharing and implementation fall into a wicked problem category. Our research, however, shows that the actual practice reflected the policy expectation well. This should convince policy makers to improve EPDS, since this project helped save thousands of lives in schools, and it may save more people if more schools in China could adopt and test these procedures and standards.

5.1 POLICY RECOMMENDATIONS

5.1.1 From pilot project to scale

Currently, EPDS is a pilot project. It needs to be expanded. Though our research case does not provide enough evidence for a grand claim on nationwide application, and China is too big for mass change at this level, I am confident to request scaling up of the current pilot project.

The schools in this study help demonstrate EPDS's effectiveness. More study is needed, of course, but it is time to expand on Chinese success. This project helped test whether such procedures and standards improve school safety during an earthquake. They do. There is also more to learn. Many cases, including this Lushan Earthquake case, have indicated the effectiveness of EPDS policy. Therefore, perhaps it is time for the EPDS project to scale up from its pilot project status as a set of demonstration schools to include a wider range of primary and secondary schools in the regions where children are more vulnerable to earthquakes.

In addition to state policy, I suggest forming voluntary EPDS teacher clubs all over China. These teachers have the EPDS training and field experience based on both the EPDS standards and their innovative thinking. The clubs may combine to strengthen EPDS standard procedures with field workers' experience. The club activities may help better improve the EPDS capacity and influence through talks with people who do not know EPDS well. The first step may be organizing the teachers who were successful in our case, help them get organized and then let them travel around to help establish volunteer clubs. The volunteers might also record the training detail, such as knowledge training and drills, and upload on to internet links so that the remote areas can acquire skills and knowledge without fully establishing EPDS system.

In China, the existing laws about emergency response and mitigation only briefly mention the role of preparation/training in the education system; yet there are no specific guidelines outlining detailed implementation procedures. Major changes will require both legislative process and government regulations. Passing a law to identify proper authorities who can both enforce and fund the implementation of EPDS policy would thus play a fundamental role in the application of the program. In addition, the law should require authorities to provide specific procedures for improving EPDS policy. Such improvement application can draw from the best practices the teachers have identified.

Local authorities currently have great liberty to implement detailed EPDS policy based on their own conditions. In some less earthquake-prone regions, governments even choose to ignore such a project, due to lack of funding and the low necessity of preparing for a low frequency disaster. Therefore, the ultimate goal for EPDS policy is a nationwide massive application integrating local circumstance. Yet as I previously mentioned, the country is too big for a sudden national change. It is good to start by scaling up the EPDS program and extending it to those areas where security is most threatened by earthquakes as Sichuan province; the EPDS program should be extended with larger coverage. In Ya'an city, there are several hundred primary and secondary schools, and the EPDS policy only covers very small amount of them (around 20 in Ya'an)(EMAS, 2012; EMAY, 2013), and thereby establishing more EPDS in such earthquake-prone regions is necessary.

The law may enforce the governments to conduct EPDS standards, yet such a law should also provide some flexibility for practitioners. For example, in less earthquake-prone regions, the preparation for earthquakes may be integrated with training for other emergencies, such as fires or floods, which also require evacuation drills along the same or similar routes.

As we discussed the flexibility of implementation, the enforcement law and regulations should balance such flexibility with compulsory details. Local authorities may integrate the laws with their own circumstance, yet it does not indicate the flexibility is so large that these governments do not implement the laws at all. There must be some basic guidelines in the laws and regulations to be defined as compulsory activities. For example, local authorizes may adapt earthquake preparation into other emergency training, such as fire drill. Yet, the drills frequency, no matter which type of emergencies it is designed for, must be regulated and enforced by the law. Similar compulsory detail should also be enforced in knowledge learning and training as well. The coordination among different stakeholders can be flexible, and the enforcement laws may recommend several template or guidelines on information sharing or working together issue.

5.1.2 Using flexible funding sources to support massive application

The scaling up of the EPDS program will no doubt require more funding than the EPDS pilot project. Poorer, more vulnerable schools may not be able to afford to properly implement the program. It will require a flexible, multiple-source funding approach. The state budget may allocate funding to less-developed provinces, and the provinces with robust economies may assist other provinces. At the local level, it may work in a similar way—rich prefectures may help poor prefectures apply EPDS requirements. This is not a completely new model of funding allocation. After the 2008 Wenchuan Earthquake, many coastal provinces, such as Shandong, Jiangsu, Zhejiang, and Guangdong, aided the Sichuan province with post-disaster recovery; these economically developed regions helped to rebuild the province infrastructures, schools, hospitals, etc.

The scaling up of EPDS will also require recurrent funding aid, since the training and building auditing and maintenance is not a one-time activity (unlike building a hospital or school). Such aid should thus become integral to a long-term design.

Social donations from NGOs, philanthropists, and the public should also play a more important role in the funding of the program, as well. In some earthquake-prone regions, such as Sichuan Province, many schools were rebuilt based on donations or funding from UN agencies such as UNICEF/UNESCO and from private philanthropists. Such donations usually become one-time projects, as well. There should be a long-term system between schools and social funding. Creating a transparent and effective system for donation usage will no doubt provide confidence to the public for its continuing participation in creating safe campuses.

In addition, the aforementioned volunteer clubs of teachers, or students/parents, who have experience with EPDS and earthquake experience may share their thoughts with those who are trying to start clubs of their own. More clubs may draw more support from club members and their social networks, and the attention of the public as well. Such a club-expansion approach may also help increasing EPDS influence and reputation to the public, and thereby increased attention may help to acquire more funding from various sources.

5.1.3 Maintaining school building quality as the basic rule of massive application policy

In this research, I repeatedly emphasize the importance of school building quality as a preventative against losses, injuries, and damage caused by earthquakes. All evacuation and other response actions become successful based on the building's survivability. If the buildings collapse, EPDS standard response procedures can hardly be conducted. Therefore, I recommend that all schools should review their building quality based on the survivability standards of local earthquake intensity predictions. Such all-school building check is of course too big for a few local inspectors, and thereby external assistance is necessary. There might be some possible assistance such as military civil engineers and volunteers with related expertise. The military force has engineers that may help local authorities to conduct building check, and as the disciplined and well-organized units, military engineers may provide effective and efficient work on such mission. Volunteers can also help check buildings. The voluntary civil engineers can both do the school building check by themselves, or train the aforementioned club members with related skills. For example, the EPDS students' parents who have such expertise might be willing to help.

The top priority of EPDS implementation is to assure the school buildings can maximally survive the earthquakes that can potentially happen in that region. A routine check on school buildings is a practical and fundamental approach for monitoring the safety of schools. If the buildings do not meet standards against earthquakes, improvement or reconstruction is no doubt a necessary procedure. Yet we cannot ignore one issue: who will pay the bill for building improvement? This question related back to the problem of EPDS funding sources. If the funding needs to cover the bill for building improvement, the budget becomes a heavy burden for many local and provincial authorities. The money to provide training is no doubt less than building improvement. Social donations can hardly meet such large requirement. Therefore, central government needs to consider adding this spent into annual budget. In China, only the central government has such capacity to cover the bill. Again, in such a large country, the building improvement cannot be implemented all at once. It should start from the weakest schools in the poorest region with earthquake threats. The project should be conducted step-by-step based on school building quality, regions' economy and earthquake threats status. In addition, avoiding the potential misuse of the funding is a very critical issue. Funding usage with transparency is no doubt an effective approach. An accessible-to-public usage report can let the public keep an eye on how the work is done and oversee the implementation of the improvement.

5.1.4 Modifying policy through retrieving ideas from faculty members and students

The policy design and modification should always fit the school circumstance. As the frontline practitioners, teachers and students may have first-hand reflections on the current policy's goodness and weakness. They are closer to the problems than any other stakeholders; their opinions should therefore be considered valuable and practical tools for policy makers to consider when modifying policy.

Our survey has revealed some valuable ideas from teachers, such as umbrella issues, evacuation route improvement and psychological assistance. I recommend that policy makers and authorities consider these opinions from teachers and students. Such ideas may provide critical insights into how we may improve the current standards and rules according to local circumstances.

The volunteer clubs of EPDS teachers, students and parents may play a significant role in policy improvement. Such clubs can organize these field practitioners, and provide larger voice (than individuals) to inform policy makers on what field workers think should change. These groups can also help other people learn the protection skills even without EPDS regulations. As I demonstrated in the information coordination chapter, such informal social networks can improve the efficiency of information sharing and learning process. Government may support such clubs by providing internet network for clubs sharing information. The current social network websites such as Renren (Chinese Facebook) and Weibo (Chinese Twitter) may also become the platform for such informal networks.

5.1.5 Improving mutual assistance capacity through community participation

Within the first couple of hours following an earthquake, mutual support and rescue is the most critical approach to save lives. EPDS policy should broaden its focus from schools to local communities and inspire the participation of all companies, organizations, and residents in a community to engage in earthquake preparation and training. In a local community, schools may provide their large, open playgrounds and fields as evacuation locations, and adults from the local communities may help rescue and support school children. Chiharu Kondo's (2013) research mentions how local construction workers participated in nursery schools' evacuation drills. Workers carried small kids and ran away from school buildings to an evacuation location. In his research on Dominican hurricane response, Serrant (2014) also provides examples of how local communities support each other following a disaster. Adults took care of major recovery issues, seniors took care of children, and kids took care of small issues that they could handle, such as pets. These cases may provide some insights for Chinese policy makers on how to integrate local communities into the EPDS framework.

In addition, the volunteer clubs may form informal networks and help organizing the local residents. The club activities, such as mutual learnings and experience sharing, can help members know and prepare each other well. When an earthquake happens, members of teachers, students and parents may respond rapidly and effectively. Through these clubs, local community may get better organized against earthquakes (members help others), and survive the first moments after earthquake without external rescue actions.

5.2 POTENTIAL CHALLENGES FOR STEPPED APPROACHED TO SCALING UP EPDS

There are still some challenges to developing EPDS policy. As the aforementioned section demonstrated, there is some difficulty in maintaining school participation in routine practice. Some schools only conduct drills as a demonstration when authorities examine the effects of EPDS policy. Such drills are more like shows for satisfying government officials, rather than practicing and educational experiences for students and faculty members.

In the current exam-oriented system, many schools spend the majority of time preparing students for exams. Other activities, such as drills, may not be a priority, especially in those regions with few disasters or emergencies. Therefore, improving the awareness of schools to potential hazards should become a routine work for the government and society. It may start from vulnerable areas where local residents are aware of earthquake threats. Then through telling successful cases and heroic stories of EPDS (which the volunteer clubs may help by traveling around and share the information), build momentum that EPDS is an important and necessary approach that should be adopted by all schools. Gaining support from the public is always a necessary approach for developing large-scale program.

The EPDS policy and future law should specifically balance necessary training time with study activities. This is a long-term project and may require not only the modification of emergency policy, but other systems reform, as well.

Although we discussed the multiple potential funding sources for massive application of EPDS, such cross-regional aid may cause conflicts of interest. Any one-time aid project may end in a foreseeable future, yet providing routine aid for a huge number of schools may become a fiscal burden for the government. Effective negotiation and discussion is necessary among stakeholders so that the funding allocation may become a long-term and stable framework.

Therefore, we may start from establishing informal networks such as EPDS clubs of teachers, students and parents for mitigation and preparation (we were discussed), and leave the high budget and complicated funding issues to post-crisis response and recovery, since the aid for the recovery are usually one-time project (rebuilding schools, hospitals, residences etc.), which can be negotiated relatively easy comparing to long-term recurrent aid such as routine preparation and training.

5.3 FUTURE RESEARCH ON SOME ISSUES

This research utilized the case of Ya'an EPDS teachers' activities before, during, and after the 2013 Lushan Earthquake, and drew conclusions and recommendations based upon the results. Although the results are solid and supported by public opinions from mass media and reports, I still wonder what EPDS teachers from other regions think about current EPDS policy. Due to the limitations of this dissertation and access to the research locations, exploring the opinions of EPDS teachers from other regions may prove illuminating.

During the findings of teachers' response, the mobile phone is a major choice for collecting earthquake information, as well as mutual support and rescue. The 3G network assures local residents to contribute their ideas and efforts for rescue and recovery without sitting next to a computer. The mobile apps of social network websites, such as Weixin (texting/twitter app), Weibo (Twitter like app), and other Facebook-like websites, indeed contributed for information sharing among local residents, and other rescue force. The rescue workers may find some very first-hand damage report from local survivors' website post, and thereby speeding up the rescue efforts. Although there were some rumors spreading among the social networks, authorities may also be aware of such rumors immediately (check websites faster than collect rumors on the field) and clarify the untrue stories, and thereby stabilize social orders more effectively. How to better integrate social network websites into preparation and response is no doubt a good further research topic. I believe that modern internet system can help flatten the communication networks, ease the preparation and accelerate the rescue and recovery efforts. Currently, many local authorities, as well as communities/organizations have established official accounts on social network websites, which may help to release and share information rapidly than traditional approach, such as radio/TV broadcasting, or newspapers.

In the regression analysis, we found a gender difference in response activities, which is another interesting topic that requires further exploration. What might be the reason for this difference? Is it a phenomenon in Ya'an, or does it hold true for other regions as well?

The topic of EPDS is relatively new in the field of disaster education, and the field of disaster education is a new research domain, as well. Other issues within EPDS will need to be researched, such as how to work out funding allocation, how students implement the practice, what are the public opinions on the policy, etc. I hope my research may inspire other researchers to further explore the issues in this field.

APPENDIX A

A.1 CONSENT SCRIPT

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Dear teachers of Earthquake Preparation Demonstrative Schools (EPDS):

Greetings!

I am Yuchi Song, a doctoral student from University of Pittsburgh of U.S.A. Currently I am working on my dissertation research to explore contemporary earthquake preparation/training in EPDS schools in China.

First, please allow me to send my deepest appreciation for the professional and heroic responses related to students' evacuations in 2013 Lushan Earthquake! Teachers' immediate actions saved many lives of students when the earthquake happened. This story has been reported by all kinds of media, and gained applause all over the world.

Therefore, our research, including this survey, intends to describe how schools prepared for the earthquake, and how they acted when the earthquake happened. We want to know how your school understood and implemented the earthquake education policies in their classes. We also would like your reflections on these policies, and how they might be improved even more.

This survey is anonymous. We need your stories not your names. There will be no identifiers recorded, which means we will not record your name, or social ID number, etc. Please feel free to ask questions. We have tried to ask no sensitive questions, so let us know if you are uncomfortable answering any of the questions. Your privacy will be protected.

We know how busy you are, and how difficult it can be to remember these things, so we very much appreciate your willingness to take the time to help up improve earthquake education policies so they can help children and teachers even more next time.

Thank you!

Yuchi Song

Ph.D. student,

Social and Comparative Analysis Program,

Department of Administrative and Policy Studies, School of Education,

University of Pittsburgh

A.2 SURVEY

SURVEY ON EPDS TEACHERS' PREPARATION, RESPONSE AND REFLECTION IN 2013 LUSHAN EARTHQUAKE

A joint effort with the University of Pittsburgh and the China Earthquake Administration

***You may choose to answer or not answer any of the questions. It is totally voluntary.**

***When a question can have multiple answers, there will be a notice in the parentheses.**

BACKGROUND INFORMATION

To better help this study describe your practice before and during the earthquake, we would first like to collect some of your background information, such as the school level in which you are teaching, your gender and age range, and the highest education you have completed. Again, we will assure you that following information will be used only within the project and not disclosed to unauthorized person or group, and it will not include any identifying information.

1. At what level of the school are you teaching?
    a. Primary school
    b. Middle school
    c. High school
2. What is your gender?
    a. Female
    b. Male
3. What is your age? (you may write it here:___or selected from below)
    a. Under 20
    b. 20-30
    c. 31-40
    d. Over 40

4. What is highest level of education you have completed?
    a. Junior teachers' school
    b. Senior teachers' college
    c. Undergraduate degree or above

EARTHQUAKE PREPARATION AND EDUCATION

This section will ask you questions regarding to your experiences of earthquake preparation and education. Several different questions will be asked, such as your awareness of the importance of earthquake preparation/education; the possibility of earthquakes in your region; what has inspired you to learn about and teach knowledge related to earthquake preparation; and how you practiced your learning and teaching earthquake skills/knowledge.

5. In your opinion, how often do earthquakes occur in your region?
    a. Never
    b. Rarely possible
    c. Possible
    d. Highly possible
6. In your opinion, how important was earthquake preparation/education in the primary/secondary school where you were teaching?
    e. Very important
    f. Important
    g. Normal
    h. Not important
7. Which of the following options inspired (or drove) you to participate in earthquake preparation/training in your school (you can choose multiple answers)?
    a. I just did the best I could for the safety of my students
    b. Following policies from authorities or school administrations seemed to be enough
    c. I just want to help
    d. I now think I need to know even more about earthquake surviving skills and knowledge than what is currently required because I think my students need it
    e. Other----please explain:

8. Since you are teaching in an Earthquake Preparation Demonstration School (EPDS), do you know which of the following EPDS qualification level your school is?
   a. National level
   b. Provincial level
   c. Local level
   d. I do not know, I'll ask
   e. Other----please explain
9. At work or in your community, have you received any form of training on the knowledge and skills needed for earthquake preparation, response and/or recovery?
   a. Yes
   b. No
10. If you chose "Yes" in question 9, from whom have you received training (you can choose multiple answers)?
    a. Official training from national or international organizations/agencies, such as China Emergency Management Office, or National Earthquake Administration, or UN/UNICEF
    b. My EPDS school training
    c. Local community training
    d. Self-learning through books, radio, video and Internet information about earthquake preparation
    e. Other----please explain:
11. Have you ever received a government authorized certificate or other recognition as a qualified earthquake preparer/educator?
    a. Yes
    b. No

12. Do you know if your school has an emergency response plan preparing for earthquake?
    a. Yes
    b. No
    c. I am unsure just now
    d. Other----please explain:

13. If you chose “Yes” in question 12, how much do you know about the plan?
    a. I know the plan and we have regularly practiced what we would do
    b. I know the plan and we have occasionally practiced what we would do
    c. I know the plan and we haven’t practiced it yet
    d. I know some of the plan, but would need to ask someone about the details
    e. Other----please explain:
14. Do you know whether your school had an earthquake resistance assessment and/or safety design in the last year (you can choose multiple answers)?
    a. Building assessment to see how safe it is depending on the degree of seismic intensity (degree 8 in Ya’an City)
    b. Safety checks on emergency exits
    c. Planned evacuation routes
    d. I know there hasn’t been a recent assessment, but there was one more than a year ago
    e. I do not know if there ever has been one
    f. Other----please explain:
15. Did your school ask you to make the following preparations for earthquake (you can choose multiple answers)?
    a. Developed/Received an earthquake preparation/response manual
    b. Developed emergency contact lists for students’ parents/guardians
    c. Prepared specific security measures such as temporary parenting/guarding students until they rejoin their families
    d. Identified and confirmed evacuation locations and routes
    e. Practice drills in case of an earthquake
    f. Other----please explain:
16. Were roles and responsibilities during an earthquake assigned to you ahead of time?
    a. Yes
    b. Yes, and the other teachers and I took on more responsibilities during the earthquake
    c. No
    d. Other----please explain:

17. In your school, how did students learn about earthquake knowledge and preparation education (you can choose multiple answers)? Such lessons include curriculum specially designed for earthquake, regular curriculum integrated with earthquake knowledge, etc., and can be taught by instructors both inside and outside your school.
    a. School-wide earthquake knowledge/safety course/talk
    b. Grade-wide course/talk
    c. Class meeting
    d. Knowledge competition or talent show with topic of earthquake preparation (drawing, writing, etc.)
    e. Other----please explain:
18. In your school, did you know the frequency of earthquake education lessons (including all form of knowledge conveying in question 17 mentioned)?
    a. Less than once per semester
    b. Once per semester
    c. More than once per semester
    d. Never
19. In your school, what was the frequency of evacuation drills?
    a. Less than once per month
    b. Once per month
    c. More than once per month
    d. Never
20. If drills were held, did they contain the following features (you can choose multiple answers)?
    a. A surprise drill without pre-notice to you and students
    b. A drill with pre-notice to you and students
    c. A drill that included parents/guardians
    d. Other----please explain:
21. How did the school inform parents/guardians about its disaster preparation education? (you can choose multiple answers)
    a. Arranged face-to-face meetings with teacher and parents/guardians
    b. Wrote letters to inform parents/guardians

c. Explained to parents/guardians by phone/text
d. Other----please explain:

WHEN THE EARTHQUAKE STRUCK AND AFTER, WHAT DID YOU DO?

This section will ask several questions regarding to your response when the earthquake struck and after. These questions cover topics such as how soon were you aware the earthquake happened, how did you respond to the earthquake, what did you do after the first tremor period passed, etc.

22. Do you know the number of students present at school at the date of earthquake:
    a. Yes (number:____)
    b. No
23. What were the students doing when earthquake struck?
    a. Working on lessons inside classroom
    b. Taking physical education on the playground
    c. On the way to school
    d. Other----please explain:
24. What did you ask your students to do when earthquake struck (you can choose multiple answers)?
    a. Hide under the tables/desks and cover their heads
    b. Evacuate outside building as soon as possible
    c. Evacuated immediately since we were on 1st or 2nd floor of the building;
    d. Told them to wait until it passed
    e. Other----please explain:
25. After the first wave of tremors passed, what did you do next (you can choose multiple answers)?
    a. Kept students organized to avoid any chaos
    b. Conducted a roll call and safety check on students inside the building
    c. Conducted a roll call and safety check on students outside the building
    d. Helped appeasing panic students
    e. Contacted other teachers/administrators or students' parents/guardians
    f. Looked for earthquake information/news
    g. Other----please explain:

26. How did you confirm the earthquake information (you can choose multiple answers)?
    a. From the principal and other teachers
    b. By mobile phone (including text message and texting apps, etc.)
    c. Via radio
    d. Via TV
    e. Via Internet
    f. By land phone
    g. From the neighbors
    h. Other----please explain:

27. To which following places did your students evacuate?
    a. Evacuated to the temporary evacuation place pre-assigned by authority
    b. Evacuated to the location pre-determined by your school
    c. Evacuated to the playground/open field without plan ahead
    d. Stayed inside the school building
    e. Other----please explain:
28. Did you know how many students were evacuated from your school?
    a. Yes (number:_____)
    b. No
29. At which of the following places did your students meet their parents/guardians (you can choose multiple answers)?
    a. At an evacuation place inside school
    b. At an evacuation place outside school
    c. Students went home by themselves
    d. Other----please explain:
30. When did you finally confirm the safety of all students (presented at school on the day of earthquake struck)?
    a. The day earthquake struck
    b. Next day
    c. The day after next day
    d. Other----please explain:

31. In your opinion when did your school finally restore its regular function?

a. Yes (Month__Day__)

b. No

What actions do you think actually work for earthquake preparation and response? (You can select multiple options)

Actions	Check "X" if you think it is useful
EPDS national training for teachers	
EPDS school training	
Community training	
Self-learning	
Learn the emergency plan of my school	
School-wide earthquake knowledge/safety course/talk	
Class meeting	
Knowledge competition or talent show with topic of earthquake preparation (drawing, writing, etc.)	
A surprise drill without pre-notice to you and students	
A drill with pre-notice to you and students	
A drill that included parents/guardians	
Arranged face-to-face meetings with teacher and parents/guardians	
Wrote letters to inform parents/guardians	
Explained to parents/guardians by phone/text	

Open-ended question:

Please feel free to discuss the reflection on your (or your school's) response and preparation in this earthquake, such as how could the policies be improved related to the kind of procedures your school might take to increase survival capacity for students/teachers/buildings in the future. Thank you so much for your time and concern.

A.3 QUESTIONS USING IN REGRESSION WITH SCORE DESIGN

2. What is your gender? (Gender question, dummy variable)
    a. Female--1
    b. Male--0
3. What is your age? (you may write it here:___or selected from below) (Age question)
    a. Under 20
    b. 20-30
    c. 31-40
    d. Over 40
4. What is highest level of education you have completed? (Education, dummy variable, option c as 1, the rest coded 0)
    a. Junior teachers' school--0
    b. Senior teachers' college--0
    c. Undergraduate degree or above --1
5. In your opinion, how often do earthquakes occur in your region? (Attitude score, full score: 3)
    a. Never--0
    b. Rarely possible--1
    c. Possible--2
    d. Highly possible--3
6. In your opinion, how important was earthquake preparation/education in the primary/secondary school where you were teaching? (Attitude score, full score: 3)
    a. Very important--3
    b. Important--2
    c. Normal--1
    d. Not important--0
7. Which of the following options inspired (or drove) you to participate in earthquake preparation/training in your school (you can choose multiple answers)? (Attitude score, full score: 4)
    a. I just did the best I could for the safety of my students--1

b. Following policies from authorities or school administrations seemed to be enough--1
c. I just want to help--1
d. I now think I need to know even more about earthquake surviving skills and knowledge than what is currently required because I think my students need it—1

9. At work or in your community, have you received any form of training on the knowledge and skills needed for earthquake preparation, response and/or recovery? (Preparation score, full score: 1)
   a. Yes--1
   b. No--0
10. If you chose “Yes” in question 9, from whom have you received training (you can choose multiple answers)? (Preparation score, full score: 10)
   a. Official training from national or international organizations/agencies, such as China Emergency Management Office, or National Earthquake Administration, or UN/UNICEF--4
   b. My EPDS school training--3
   c. Local community training--2
   d. Self-learning through books, radio, video and Internet information about earthquake preparation--1
11. Have you ever received a government authorized certificate or other recognition as a qualified earthquake preparer/educator? (Preparation score, full score: 1)
   a. Yes--1
   b. No--0
12. Do you know if your school has an emergency response plan preparing for earthquake? (Preparation score, full score: 1)
   a. Yes--1
   b. No--0
   c. I am unsure just now--0
13. If you chose “Yes” in question 12, how much do you know about the plan? (Preparation score, full score: 4)
   a. I know the plan and we have regularly practiced what we would do--4

b. I know the plan and we have occasionally practiced what we would do--3
c. I know the plan and we haven't practiced it yet--2
d. I know some of the plan, but would need to ask someone about the details--1

14. Do you know whether your school had an earthquake resistance assessment and/or safety design in the last year (you can choose multiple answers)? (Preparation score, full score: 3)
    a. Building assessment to see how safe it is depending on the degree of 1seismic intensity (degree 8 in Ya'an EPDS)--1
    b. Safety checks on emergency exits--1
    c. Planned evacuation routes--1
    d. I know there hasn't been a recent assessment, but there was one more than a year ago 0
    e. I do not know if there ever has been one 0
15. Did your school ask you to make the following preparations for earthquake (you can choose multiple answers)? (Preparation score, full score: 5)
    a. Developed/Received an earthquake preparation/response manual--1
    b. Developed emergency contact lists for students' parents/guardians--1
    c. Prepared specific security measures such as temporary parenting/guarding students until they rejoin their families--1
    d. Identified and confirmed evacuation locations and routes--1
    e. Practice drills in case of an earthquake--1
16. Were roles and responsibilities during an earthquake assigned to you ahead of time? (Preparation score, full score: 2)
    a. Yes--1
    b. Yes, and the other teachers and I took on more responsibilities during the earthquake--2
    c. No--0
18. In your school, did you know the frequency of earthquake education lessons (including all form of knowledge conveying in question 17 mentioned)? (Preparation score, full score: 3)
    a. Less than once per semester--1

b. Once per semester--2
c. More than once per semester--3
d. Never--0

19. In your school, what was the frequency of evacuation drills? (Preparation score, full score: 3)
    a. Less than once per semester--1
    b. Once per semester--2
    c. More than once per semester--3
    d. Never--0
20. If drills were held, did they contain the following features (you can choose multiple answers)? (Preparation score, full score: 4)
    a. A surprise drill without pre-notice to you and students--2
    b. A drill with pre-notice to you and students--1
    c. A drill that included parents/guardians--1
21. How did you inform parents/guardians about its disaster preparation education? (you can choose multiple choices) (Preparation score, full score: 3)
    a. Arranged face-to-face meetings with teacher and parents/guardians--1
    b. Wrote letters to inform parents/guardians--1
    c. Explained to parents/guardians by phone/text--1
24. What did you ask your students to do when earthquake struck (you can choose multiple answers)? (Best practice score, full score: 3)
    a. Hide under the tables/desks and cover their heads--1
    b. Evacuate outside building as soon as possible--1
    c. Evacuated immediately since we were on 1^{st} or 2^{nd} floor of the building;--1
    d. Told them to wait until it passed--0
25. After the first wave of tremors passed, what did you do next (you can choose multiple answers)? (Best practice score, full score: 6)
    a. Kept students organized to avoid any chaos--1
    b. Conducted a roll call and safety check on students inside the building--1
    c. Conducted a roll call and safety check on students outside the building--1
    d. Helped appeasing panic students--1

e. Contacted other teachers/administrators or students' parents/guardians--1
f. Looked for earthquake information/news--1

26. How did you confirm the earthquake information (you can choose multiple answers)? (Best practice score, full score: 7)
    a. From the principal and other teachers--1
    b. By mobile phone (including text message and texting apps, etc.)--1
    c. Via radio--1
    d. Via TV--1
    e. Via Internet--1
    f. By land phone—1
    g. From the neighbors—1
27. To which following places did your students evacuate? (Best practice score, full score: 3)
    a. Evacuated to the temporary evacuation place pre-assigned by authority--3
    b. Evacuated to the location pre-determined by your school--2
    c. Evacuated to the playground/open field without plan ahead--1
    d. Stayed inside the school building--0
29. At which of the following places did your students meet their parents/guardians (you can choose multiple answers)? (Best practice score, full score: 2)
    a. At an evacuation place inside school--1
    b. At an evacuation place outside school--1
    c. Students went home by themselves--0
30. When did you finally confirm the safety of all students (presented at school on the day of earthquake struck)? (Best practice score, full score: 3)
    a. The day earthquake struck--3
    b. Next day--2
    c. The day after next day--1

APPENDIX B

B.1 A COPY OF THE INSTITUTIONAL REVIEW BOARD (IRB) CERTIFICATE

As seen in the copy of the email correspondence below, the office of the Institutional Review Board (IRB) approved the survey study “The policy development of disaster management and education in China ---- the comparison between policy expectation and actual implementation of earthquake education in schools” as an exempt study as of November 25th, 2013. The application to the IRB also specified the use of the data collected using the listed research instruments for my dissertation research purpose.

PI Notification: IRB determination 收件箱 x

irb@pitt.edu 11月25日 (5 天前)

发送至 yus31

University of Pittsburgh

Institutional Review Board

3500 Fifth Avenue
Pittsburgh, PA 15213
(412) 383-1480
(412) 383-1508 (fax)
http://www.irb.pitt.edu

Memorandum

To: Yuchi Song

From: Christopher Ryan PhD, Vice Chair

Date: 11/25/2013

IRB#: PRO13070019

Subject: The policy development of disaster management and education in China----the comparison between policy expectation and actual implementation of earthquake education in schools

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The above-referenced project has been reviewed by the Institutional Review Board. Based on the information provided, this project meets all the necessary criteria for an exemption, and is hereby designated as "exempt" under section
45 CFR 46.101(b)(2)

Please note the following information:

- If any modifications are made to this project, use the "**Send Comments to IRB Staff**" process from the project workspace to request a review to ensure it continues to meet the exempt category.
- Upon completion of your project, be sure to finalize the project by submitting a "**Study Completed**" report from the project workspace.

Please be advised that your research study may be audited periodically by the University of Pittsburgh Research Conduct and Compliance Office.

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B.2 RESEARCH MATERIALS SUBMITTED TO THE IRB

The materials submitted to the IRB included:

- Letter from the director of China Emergency Management Office for cooperation request in the project.
- Letter from the director of the Earthquake Mitigation Administration of Sichuan Province for cooperation request in the project.
- Letter from the director of the Earthquake Mitigation Administration of Ya'an Metropolis for cooperation request in the project.
- Letter from the vice chairman of Education, Science, Culture and Health Committee of Shandong Provincial Congress for permission of researcher's understanding on local cultural and social norms.
- Consent script for the survey to the EPDS teachers in Ya'an Metropolis.
- Research Instrument: Multiple-choice and open-ended survey questionnaire.

All the materials were prepared in both English and Chinese for the study implementation, and the English version materials were submitted to IRB.

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