

Paper:

Development of NERSS Training Program for Earthquake Emergency Response Capacity Building of Local Governments

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Responses to medium-magnitude earthquakes are as significant as to catastrophic earthquakes, because medium-magnitude temblors occur as many as a dozen times more than catastrophic earthquakes – at least from the year 1900. In China, local governments are obligated to protect residents against earthquakes that have a magnitude of $M_s 6.0$. The ways in which local governments perform these obligations differ, however, due to obstacles such as inadequate disaster planning, a lack of public earthquake awareness, and a shortage of qualified emergency managers. When an earthquake hits, the hazards that residents are unaware of may arise concurrently, putting thousands lives and millions of acres of property in danger. In short, the response capacity of local governments is crucial to an earthquake's aftermath.

To enhance the capacity of local government response to earthquake emergencies, the National Earthquake Response Support Service (NERSS) of China started work on training programs years ago. With the cooperation with the Japan International Cooperation Agency (JICA) and Japanese scientists in the last five years, based on lessons learned from China's historical earthquakes and disasters, the authors have created the prototype for an earthquake disaster management curriculum, which it has then been demonstrated and continuously improved. This paper reviews the prototype curriculum and its development methodology, presents demonstrative deliveries of the curriculum, and discusses training effectiveness and further improvements. Applying an international emergency management framework and related experience, focusing on local government capacity building, the demonstrative trainings have been proved to be beneficial to local government response activities and the latest amendment to earthquake preplanning in China. Future systematic tracking research of training effectiveness is proposed to keep curriculum updating and appropriate as times change.

Keywords: earthquake, emergency response, training program, capacity building, local governments

1. Introduction

1.1. Occurrence of More Minor Earthquakes

In the short 6 years since 2008, at least 99 earthquakes of a magnitude exceeding $M_s 5.0$ have hit mainland China. Statistics (Table 1) also show that in mainland China since 1900, the occurrence of earthquakes of $M_s 6.9$ or less magnitude is 20 times per year, while $M_s 7.0$ or greater earthquake occurs 3 times every four years. Minor earthquakes occur even more frequently.

1.2. Local Government Domination in Response to Minor Earthquakes

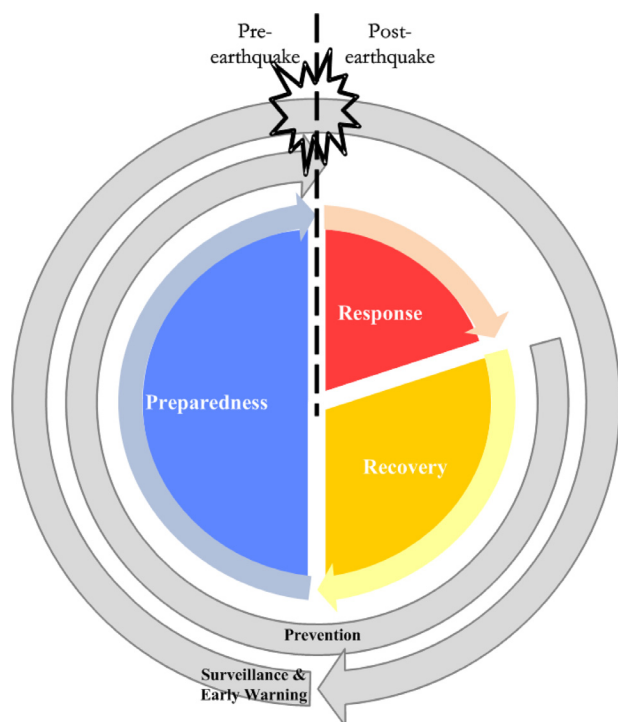
One of the principles of China's National Earthquake Emergency Plan is its territory-based graded response to earthquakes. Depending on earthquake impact, response is divided into four levels. A level I response, i.e., the highest, means a national response that may require mobilizing resources from the whole country in relief efforts. A level II response is dominated by provincial governments, a level III response by city governments and a level IV response by county governments.

1.3. Training Program Needs for Earthquake Emergency Response Capacity Building by Local Governments

In earthquakes, disaster responders from local governments are required to gather and send information, make decisions, and coordinate activities with other sections, departments, and organizations, etc., as rapidly and appropriately as possible under extraordinary circumstances. Inadequate disaster planning, a lack of public earthquake awareness, and a shortage of qualified emergency managers help make the situation more difficult. When an earthquake hits, these hazards may all arise at the same time, endangering thousands of lives and millions of acres of property.

Table 1. Earthquake occurrence statistics for mainland China since 1900.

Magnitude	Frequency (times per year)
M_s 5.0–5.9	16
M_s 6.0–6.9	4
M_s 7.0–7.9	0.667
Greater than M_s 8.0	0.083

**Fig. 1.** China's earthquake administration system.

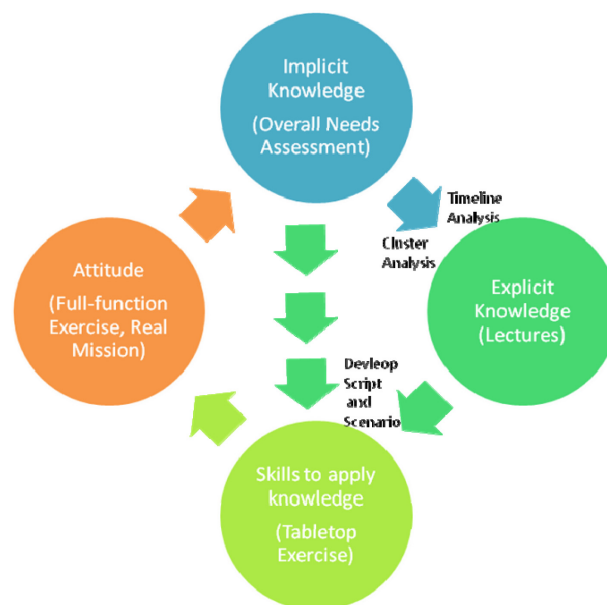
The need by local governments for training in earthquake emergency response capacity building was identified by J. Zhang (2013) [7], but no such training programs have been reported. For effectively responding to frequent earthquakes requires that a training program be developed to enhance the response capacity of China's local governments.

2. Methodology and Approach

In China, the earthquake administration system consists of three subsystems: surveillance and early warning, prevention, and disaster management, which are three cycles as shown in **Fig. 1**. The surveillance and early warning subsystem was first of the three subsystems to be established in 1966. The second subsystem, prevention subsystem is to mitigate or prevent structural damage from earthquakes. It was set up after the July 28, 1976, Tangshan earthquake. In 1988, a M_s 7.6 earthquake following by a M_s 7.2 aftershock killed 743 residents and injured 4,105 in Yunnan Province while displacing some 2 million. Recovery and reconstruction from the earthquake cost so much effort that may beyond local capacity. Assistance

Table 2. Training needs assessment interview matrix.

Seismic background	Historical earthquake
	Seismic activity trend
	Active faults
	Design seismic intensity
Economic & social development	Geological and geographical environment
	Demography
	Buildings
	Transportation
	Power supply
	Communication system
	Gas supply
	Industry
	Education
	Medical services
Emergency management system	Organizational arrangements
	Planning
	Human resources
	Equipments & Relief goods
Cases of earthquake response	Technological Support system
	Seismic parameters
	Direct damages
	Secondary hazards and impacts
	Organizational adjustments
	Timelines of response activities

**Fig. 2.** Curriculum design model.

from national and provincial governments was highly expected. It was also the first time that international assistance for natural disaster was accepted by the Chinese government as presented by S. Chen et al. (1989) [1]. Later in 1989, earthquake disaster management became the third subsystem of earthquake administration system on the national level, including three phases of preparedness, response, and recovery.

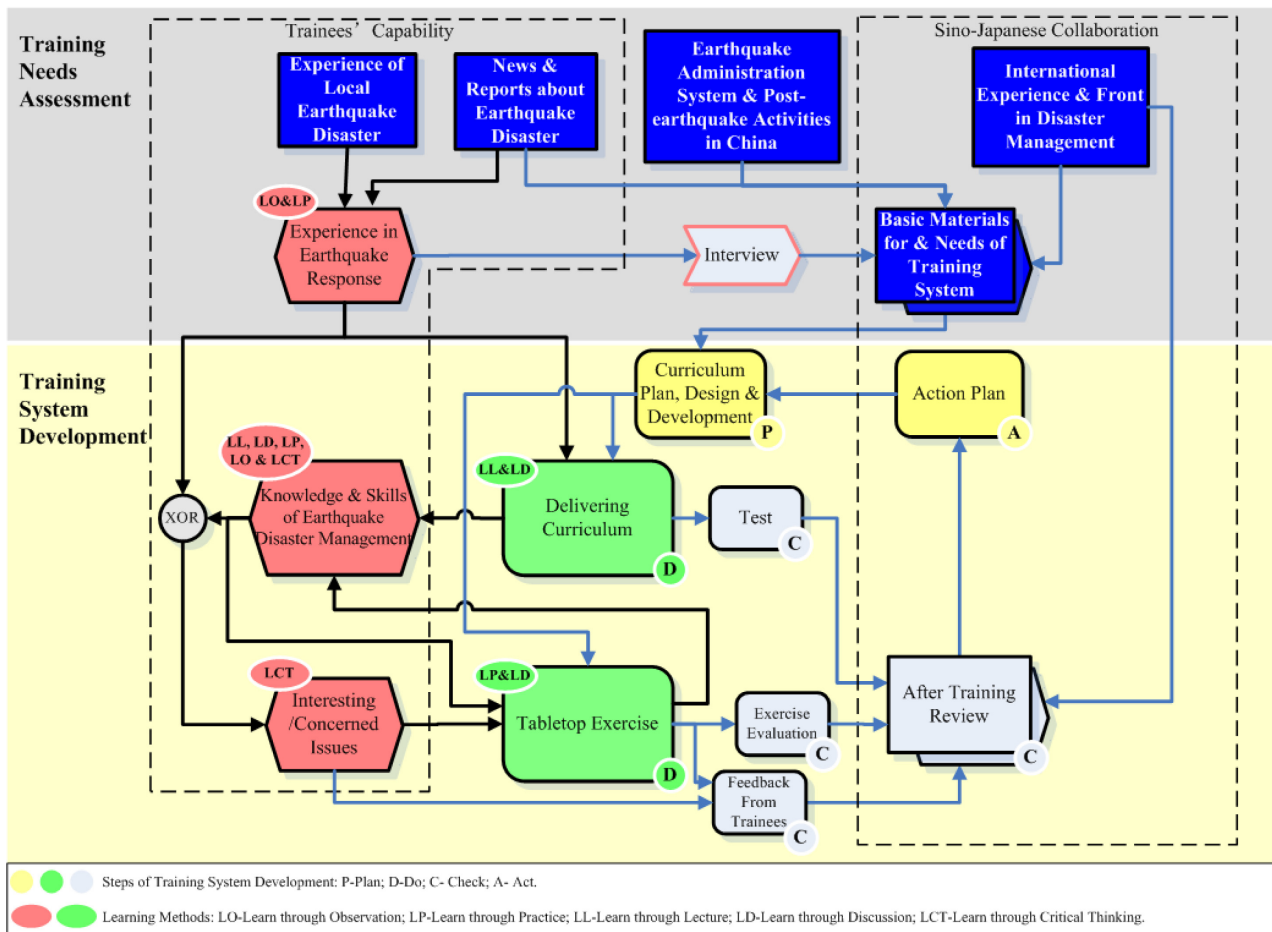


Fig. 3. Development flowchart of earthquake disaster management training.

Based on the Chinese earthquake disaster management cycle concept model and supported by the China Earthquake Administration (CEA) and the Japan International Cooperation Agency (JICA), trainers from China's National Earthquake Response Support Service (NERSS) have been working closely with Japanese scientists since May 2009 to develop a training system tailored for emergency managers in China.

2.1. Assessment of Training Needs

To develop a practical curriculum, NERSS has collaborated closely with local authorities, including those in Sichuan and Qinghai Provinces, Shanghai and three model provinces picked by the Joint Committee of the CEA-JICA project. Questionnaires and interviews (Table 2) are used to identify training needs and to generalize basic materials for courses developed later.

After training, issues and ideas of trainees employed by local authorities are shared among trainees, trainers, and Japanese professors, as reflected in post training reviews.

2.2. Learning Model for Curriculum Design

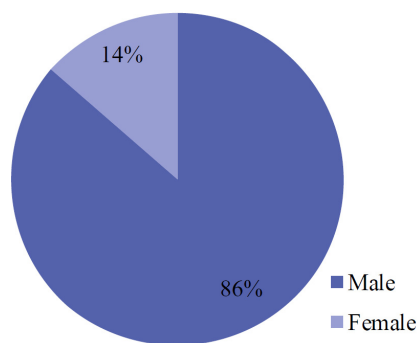
Learning is a process of imitation and emulation with the goal to acquire certain knowledge, skills, and attitudes. Bransford (2000) [4] states that "...to develop

competence in an area of inquiry, students must not only have a deep foundation of factual knowledge and understand facts and ideas in the context of a conceptual framework, but also organize knowledge in ways that facilitate retrieval and application." Hayashi (2009) [2] also defined a learning process that combines three elements of human resource development: learning, drilling, and exercising. From the specific aspect of training emergency responders, lectures, discussions, critical thinking and practice should be considered as having equal importance. Both lectures and exercises should be incorporated into a curriculum to provide trainees with sufficient opportunities to develop competence in earthquake disaster management.

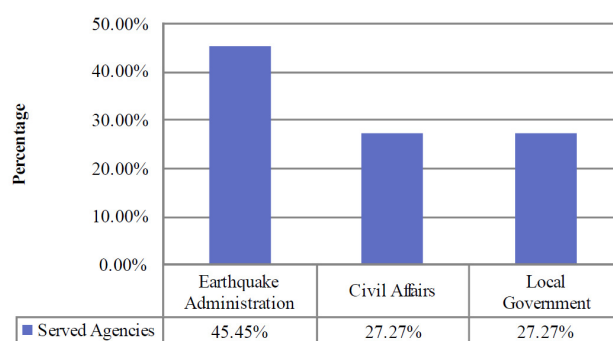
To combine lectures and exercises in curriculum design effectively, a learning model such as that shown in Fig. 2 must be developed. Information collected during needs assessment is used both to understand the background of trainees and as a complete emergency response package experience filled with "implicit knowledge." Using cluster analysis and timeline analysis techniques upon these basic materials helps make some knowledge easy to understand and interpret. This "explicit knowledge" is delivered and emphasized in lectures. Exercise scenarios are developed based on cases of earthquake response collected in needs assessment interviews. In this step, trainees may integrate explicit knowledge with their own

Table 3. Demonstrative trainings.

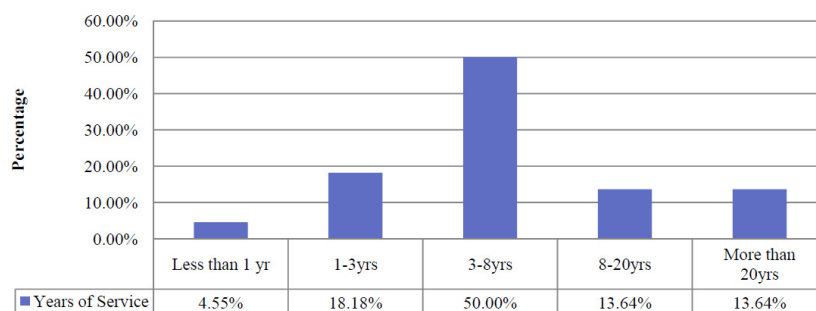
Time	Mar., 2012	May, 2012	Jul., 2012	Oct., 2012	Nov., 2012	Mar., 2013	Apr., 2014
Location	Beijing	Kunming	Nanjing	Shijiazhuang	Beijing	Beijing	Shanghai
Where Trainees are from	Hebei	Yunnan	Jiangsu	Hebei	Dalian, Beijing	Hebei, Jiangsu, Yunnan	Shanghai
Population of trainees	22	39	50	24	24	42	25



(a) Gender distribution



(b) Distribution of served agencies



(c) Distribution of years of service

Fig. 4. Statistics on trainees.

experience to acquire skills for applying them in simulated scenarios presented in tabletop exercises.

2.3. Curriculum Development Flow

From the aspect of curriculum development, the quality of all courses has been recognized as crucial and a plan-do-check-action (PDCA) methodology has thus been used to manage the entire process (**Fig. 3**). Specifically, “P” involves planning and designing curriculums and developing courses. “D” involves delivering lectures and conducting tabletop exercises. “C” involves testing just how much of the knowledge trainees master from that transferred in lectures, evaluating the skills that trainees have developed in training, gathering feedback from trainees, and analyzing the strengths and weaknesses of the training system. “A” involves compiling action plans for further improvement.

3. Results

3.1. Demonstrative Training

From March 2012 to April 2014, six training sessions have been demonstrated for trainees from Beijing, Yunnan

Province, Jiangsu Province, Hebei Province, Dalian, and Shanghai. Demonstrative training is detailed in **Table 3**. During each training session, trainees were encouraged to share knowledge and experience from their daily work in lectures. In table-top exercises, they were divided based on affiliations into three groups to simulate response activities after a level II earthquake disaster strike.

Trainees mainly came from three different systems:

- (1) Earthquake Administration, which is responsible for earthquake disaster management policy making
- (2) Civil Affairs, which is in charge of the preparation, deployment and distribution of relief supplies related to the basic survival needs of victims, e.g., water, instant food, and tents, and in charge of treating remains of the deceased in each type of disaster
- (3) Local governments

Trainees are quite diverse from the aspect of disaster management experience. Distributions of gender, agencies served and years of service of trainees are shown in **Fig. 4**.

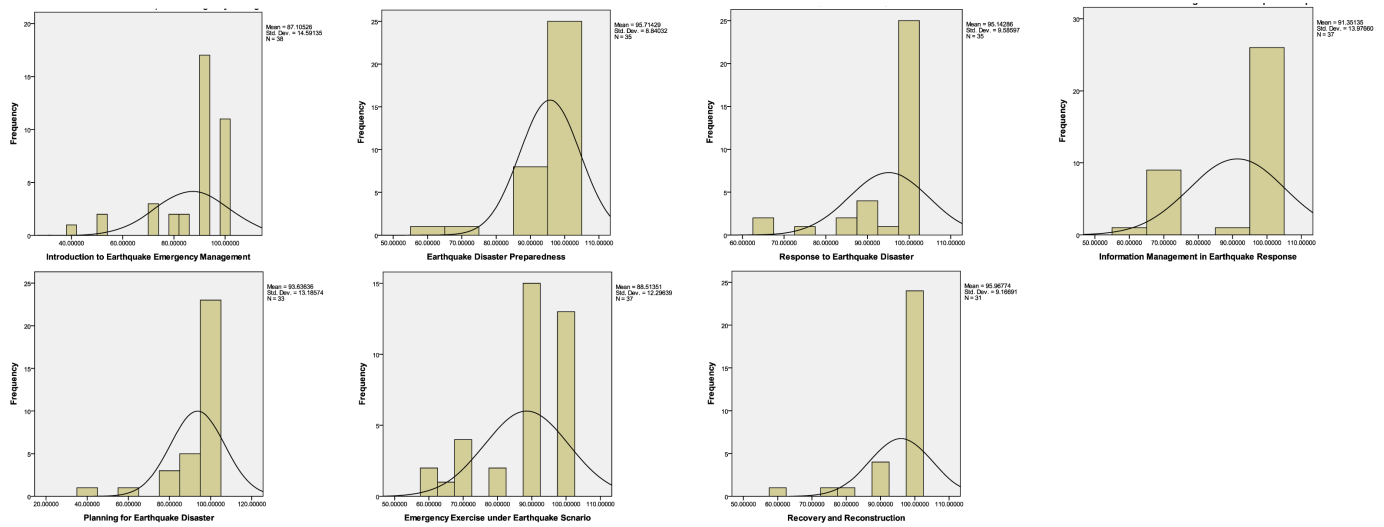


Fig. 5. Confirmatory evaluation results of demonstrative training in Kunming in May 2012.

Table 4. Feedback from trainees.

No.	Feedback aspect	Average	Highest	Lowest
1	Curriculum concentrates on the theme of “earthquake disaster management” (Out of 100%)	93.6%	100%	80%
2	Curriculum practicality (out of 100%)	72.7%	100%	40%
3	Curriculum novelty (out of 5)	4.45	5	3
4	Curriculum consistency (out of 5)	4.55	5	3
5	Send-outs (out of 5)	4.6	5	4
6	Trainers’ skills (out of 5)	4.59	5	3
7	Design of tabletop exercise, including scenarios setup, injections, etc. (Out of 5)	4.60	5	3
8	Tabletop exercise add-values (out of 5)	4.67	5	4

3.2. Confirmatory Evaluations

After each lecture in the demonstrative trainings, a confirmatory evaluation knowledge test was given to trainees. As an example, the results of each test in the demonstrative training in Kunming in May 2012 are shown in Fig. 5. Confirmatory evaluation results are negative skew distributions, which proved the high mastery of relative knowledge by trainees through demonstrative training.

3.3. Feedback from Trainees

Feedback from trainees was collected through 20-question questionnaires. These consisted of four factual questions, thirteen ordinal polytomous questions and three open-ended questions. All questionnaires have been recycled and results of feedback are shown in Table 4.

4. Discussion

4.1. Customizing Curriculum to Local Needs Essential

Assessing local needs is very important in course selection and curriculum design. Pre-training assessment should cover both trainee opinion and local knowledge, including seismic background, economic and social development, emergency management systems and cases of

earthquake response reflecting and specifically addressed in curriculums.

4.2. Scenario-Based Teaching Enhancing Training Experience

Earthquake response training belongs to the science of management to which case studies are vital. Lectures should combine interpretation with best practice to precisely and vividly deliver ideas. And in Exercises, time pressure and visual and auditory information on disaster scenarios should stimulate trainees to release their own potential to deal with crisis. Direct evidence obtained in demonstrative training shows that trainees value the add-value of tabletop exercises of 4.67 out of 5, which is the highest evaluation of all items.

4.3. Flow of Knowledge as Training Program Core

This study has developed a learning model for curriculum design, which promotes learning systematically, effectively and efficiently. Tools including timeline analysis, cluster analysis, scenario reproduction are found useful in extracting knowledge from experience and in testing knowledge. The flow of knowledge conducted in lectures and exercises throughout the learning process is the core of training program and contributes to its consistency.

5. Conclusions

Feedback from demonstrative training is generally good. The learning model, i.e., “lecture, drilling, and exercising” has been validated. Further work should next be done in eliminating the outer effects and then revealing more significant factors that function on training effects. Applying an international emergency management framework and experience and focusing on local government capacity building, demonstrative training has proved to be beneficial in local governments’ response activities and the latest amendment to earthquake preplanning in China. Future systematic tracking research on training effectiveness is proposed to keep curriculums updated and appropriate as times change.

Acknowledgements

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