

Disaster Prevention Literacy among School Administrators and Teachers: A Study on the Plan for Disaster Prevention and Campus Network Deployment and Experiment in Taiwan

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Abstract: Taiwan is located at the high-risk region of natural disasters with the frequently occurred earthquakes. The importance of the disaster prevention education on campus is made even more obvious by the fact that natural disasters often occur during the school days. Given the leading roles the school administrators and teachers playing in the disaster prevention education of their pupils, this study purposed to investigate how disaster prevention literacy was among them and how disaster prevention literacy differed across various background variables of them. Furthermore, the current study also examined if disaster prevention literacy changed by participation in the disaster prevention education program. The results suggested that, among three dimensions of disaster prevention literacy (i.e., knowledge, attitude, & skills) the participants were highest on disaster prevention skills and lowest on disaster prevention knowledge. Additionally, three dimensions of disaster prevention literacy of the participants differed by school level, age, years of service, personal disaster experience, and school disaster-stricken status. The participation in the disaster prevention education program was also related to participants' disaster prevention literacy. The implications of the above findings were discussed and the recommendations were also made for future disaster prevention education programs and research.

Key word: Disaster prevention education on campus, literacy, knowledge, attitude, skills.

1. Introduction

Taiwan is located at the disaster-prone Pacific Ring of Fire with the high risk of various natural disasters like earthquakes, typhoons, and so forth. According to Natural Hazards Risk Atlas 2014 released by Verisk Maplecroft [1], Taiwan was ranked the third worldwide in terms of the Natural Hazard Risks—Absolute Economic Exposure Index with the extreme risk. Therefore, the threat of natural disasters to the lives and properties of Taiwanese people cannot be stressed enough.

As the old saying goes, prevention is better than cure. By the same token, disaster prevention education

prior to the actual disaster occurrence will be more important than the post-disaster remedy [2]. Disaster prevention education will lay the indispensable foundation of disaster prevention and rescues. Therefore, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations International Strategy for Disaster Risk Reduction (UNISDR) have promoted the disaster prevention education at school since 2006 with the goals of incorporating disaster risk reduction knowledge into relevant sections of school curricula and encouraging the application of disaster-resisting building codes to school buildings for better campus safety [3]. Taiwanese government has also ardently pushed for campus disaster prevention education since 2005 and cultivated many schools as the so-called

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“seed schools” of disaster prevention education [4]. However, due to the primacy of academic achievement in Taiwanese education system, the knowledge and skills of disaster prevention on campus are only emphasized at school during the disaster prevention drills mandated by the local school boards and seem to be lacking among public school students [5]. But, as suggested by Jyh-Shi Tan [6], disaster prevention should be taught at school since it is a responsibility not only for the government but also for everyone. Given the pivotal role the public school teachers in student education, the adequate disaster prevention literacy on their part will be essential for the disaster prevention education at school [7]. Accordingly, this study purposed to examine the disaster prevention literacy among school teachers in Taiwan as a follow-up evaluation of the 2013 disaster prevention education program sponsored by the Taiwanese government. Specifically, the following research questions were empirically investigated:

(1) How is the disaster prevention literacy among the administrators and teachers from selected schools in Taiwan?

(2) How will each dimension of disaster prevention literacy (i.e., knowledge, attitude, & skills) differ across the background characteristics (i.e., school level, job title, gender, age, highest education, years of service, school location, disaster experiences, and disaster-stricken status of the school) of the administrators and teachers from selected schools in Taiwan?

(3) How will each dimension of disaster prevention literacy (i.e., knowledge, attitude, & skills) differ across the administrators and teachers participating in the disaster prevention education program and the teachers not participating in the disaster prevention education program from selected schools in Taiwan?

2. Literature Review

2.1 Disaster Prevention

According to the Disaster Prevention and Protection

Act [8] in Taiwan, disaster prevention is defined as “the measures of disaster prevention, disaster response, and post-disaster recovery and rehabilitation.” Therefore, the concept of disaster prevention is expanded to encompass disaster prevention and disaster rescues. Furthermore, the concept of disaster management is also incorporated into the concept of disaster prevention. Disaster management denotes the management procedures and methods of disaster mitigation, disaster preparedness, disaster response, and disaster recovery for natural and human-made disasters. More elaboration on the components of disaster management [9] is presented in the subsequent sections.

2.2 Disaster Mitigation

Disaster mitigation is primarily regarding the prevention of disaster occurrence or the reduction of disaster adverse impact via policies and various coping measures. There are structural disaster mitigation, non-structural disaster mitigation, and infrastructural disaster mitigation. Structural disaster mitigation is to reduce disaster risks by reinforcing buildings and constructed facilities. Non-structural disaster mitigation is to reduce disaster risks by policies and administrative measures such as using the tax break to encourage the community development in a low-risk area or issuing the communal insurance policy to buffer the property loss. Infrastructural disaster mitigation is to reinforce the critical infrastructure, such as the water supply system or power plants, to reduce the casualties caused by damaged infrastructure.

2.3 Disaster Preparedness

Disaster preparedness is the preparation for potential disasters and includes the analysis of disaster risks, the establishment of early warning systems, the training of emergency rescues professionals, and the training of local residents.

2.4 Disaster Response

Disaster response is regarding the coping measures

in the event of disasters, including the mobilization of the rescue manpower, the initiation of the emergency medical services, the evacuation and placement of the disaster-affected people, and the installation of expedient infrastructure according to the contingency plan.

2.5 Disaster Recovery

Disaster recovery is the restoration of infrastructure, facilities, livelihoods, and living conditions in disaster-affected communities. It will include the repairs for the immediate subsistence needs, the restoration of local facilities and industries, and the rehabilitation of the damaged buildings.

2.6 Disaster Prevention Education Program

The on-campus disaster prevention education program is designed to enhance the knowledge, attitude, and skills in the prevention of natural, human-made and complex disasters so that the participants at school can promptly respond to the disasters to save their lives. Disaster prevention education promotes the use of proactive measures to cope with disasters. Therefore, the intent of disaster prevention education is to cultivate not only the understanding of disaster prevention but also the capabilities to take the precautionary measures for disaster prevention on the part of trainees [10]. Here, the fundamental idea underlying disaster prevention is not to control the occurrence of disasters but to mitigate or reduce the disaster-induced damages to humans [10]. Specifically, there are four stages in the implementation of the disaster prevention education program [4]:

(1) Mobilize faculty and students to learn of the local environments and the issues related to campus safety, disaster prevention, and disaster response.

(2) Discuss the issues and strategies related to disaster prevention and formulate the preliminary plan of disaster prevention. Then, on the one hand, implement the measures of disaster mitigation to

reduce the chance of disaster occurrence, and, on the other hand, emphasize the emergency preparation and response strategies.

(3) Prepare and drill for emergency response strategies.

(4) Form the consensus promptly regarding the campus rehabilitation plan to rebuild the campus and restore the damaged buildings and facilities to the normal or close to normal function.

2.7 Disaster-proof Campuses Campaign in Taiwan

The Agency of Information and Technology Education, Ministry of Education in Taiwan was implementing the Plan for Deployment and Experiment of Campus Disaster Prevention Network from 2011 to 2014 to establish disaster-proof campuses in different regions. With hazard awareness, risk communication, disaster adaptation, and self-help capability as the core concepts, school teachers and students were cultivated to possess disaster prevention literacy and safety awareness. Accordingly, school disaster prevention and campus safety could be enhanced. Furthermore, the target schools served as the regional promotion bases of campus disaster prevention and community disaster prevention to establish the campus disaster prevention network and arouse the awareness of the importance of disaster prevention, disaster preparedness, and emergency response among general population.

Part of the Plan for Disaster Prevention and Campus Network Deployment and Experiment was to subsidize high schools, middle schools, and elementary schools to establish disaster-proof campuses. The schools were divided into three groups:

(1) Category-1 schools (i.e., partner schools) to establish disaster-proof campuses: set up the campus disaster prevention task force teams, assess the trend of local disasters, compile the disaster prevention campus map, establish the campus disaster prevention and rescues plan, conduct the disaster evacuation drills, and design localized disaster prevention curricula.

(2) Category-2 schools (i.e., leader schools) as the bases to promote disaster-proof campuses: train disaster prevention professionals, set up the mechanism of resource sharing and division of labor for disaster prevention, and facilitate the establishment of disaster-proof campuses in the category-1 schools.

(3) Category-3 schools (i.e., innovator schools) to localize and innovate the disaster prevention education: role-play the community-wide disaster prevention drills, establish the disaster prevention bases for the local community, and innovate the disaster prevention education.

In total, 155 schools were subsidized by the Ministry of Education, Taiwan to exemplify the establishment of disaster-proof campuses. Among those schools, 62 were selected by the expert review panel as the schools with outstanding performance in establishing disaster-proof campuses.

2.8 Conceptual Framework of Disaster Prevention Literacy

Disaster prevention literacy is the vital component of disaster prevention education. In order to equip the school teachers with the essential understanding of disaster prevention, their disaster prevention literacy needs to be cultivated first [11].

Literacy can be operationally defined as “the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying context” [12]. And it involves a continuum of learning which will enable individuals to achieve their goals, develop their knowledge and potentials, and fully participate in the community and wider society [12]. As to disaster prevention literacy, it can be conceptualize as the development of the proactive attitude to apply disaster prevention knowledge to cope with the disasters and the capabilities to rehabilitate and improve life after the disasters. Disaster prevention literacy is also defined as the composite of multiple capabilities and skills,

including cognition, skills, and emotion, which will enable an individual to respond, analyze, and reflect in the face of disasters for the well-being of his or her life [13]. In general, disaster prevention literacy is composed of correct understanding of life-threatening disasters, proactive attitude to disaster information and disaster prevention, and adequate capabilities and skills for disaster prevention [7]. Specifically, disaster prevention literacy consists of three dimensions of (1) disaster prevention knowledge, (2) disaster prevention attitude, and (3) disaster prevention skills. Furthermore, there are eight categories subsumed under these three dimensions:

(1) Disaster prevention knowledge: disaster knowledge, preparedness knowledge, and response knowledge.

(2) Disaster prevention attitude: prevention awareness, prevention values, and prevention sense of responsibility.

(3) Disaster prevention skills: preparedness action and response behaviors.

The descriptors of eight categories are listed in Table 1.

2.9 School Teacher Disaster Prevention Education

Elementary school education lays the foundation for all future school education. Therefore, the elementary school teachers’ attitude toward the importance of disaster prevention education will have a bearing on the success of disaster prevention education [14]. If school teachers can pass on the correct attitude and understanding of disaster prevention to their pupils, the behaviors of the pupils can be changed. As suggested by Kuo-Cheng Chen [15], education can cultivate correct understanding of, proactive attitude toward, and positive value of the environments.

According to the past research [14, 16, 17], elementary school teachers in Taiwan possessed a medium to high level of knowledge and skills in disaster prevention and an positively leaning attitude toward disaster prevention. However, female teachers

Table 1 Dimensions, categories, and descriptors of disaster prevention literacy.

Dimension Category	Descriptor
Knowledge	
Disaster knowledge	
	Synthesize and analyze the definitions and causes of various disasters
	Explain the impacts and harms of disasters to humans and their environment
Preparedness knowledge	
	Develop the disaster mitigation procedures
	Make the action plan of disaster mitigation and preparedness
Response knowledge	
	Decide the response procedures in the event of a disaster
	Design the measures of post-disaster rescues and medical cares
Attitude	
Prevention awareness	
	Evaluate the environment comprehensively and recognize the potential hazards
	Synthesize and analyze the disaster-related information proactively
Prevention values	
	Promote the importance of disaster prevention, disaster relief, and evacuation plan
	Explain the relation between disaster prevention and social cost
Prevention sense of responsibility	
	Organize the promotion of campus and community disaster prevention
	Plan the execution of campus evacuation and shelter placement
Skills	
Preparedness action	
	Plan the escape routes and sites in the event of a disaster
	Plan and participate in the drills and training for disaster prevention and relief
Response behaviors	
	Ensure self-safety and help others to escape in the event of a disaster
	Cooperate during the evacuation and shelter placement

seemed to have a more positive attitude toward disaster prevention [6]. The results in another study [14] suggested that 99.60% of the elementary school teachers in southern Taiwan recognized the importance of disaster prevention education but only 61.00% of them perceived themselves as being capable of conducting disaster prevention education. Chen-Ming Lee [16] found that, among elementary school teachers, disaster prevention knowledge differed across gender and school positions and disaster prevention attitude varied across gender, ages, and years of teaching. However, the conflicting findings were found in more recent studies for school positions [11], for ages [17, 18], and for years of teaching [18].

Overall, past research focused on school teachers' disaster prevention literacy and how their disaster prevention literacy differed across background variables. In the current study, the participation in the disaster prevention education program was also included to assess if disaster prevention literacy changed across the participants in the disaster prevention education program and the non-participants.

3. Methods

3.1 Participants

The study participants were school administrators and teachers from 62 schools with outstanding performance in establishing disaster-proof campuses and teachers from randomly selected control schools

of the similar student body sizes in the same regions. They participated in the study by responding to the online survey of disaster prevention literacy between January 2015 and March 2015. In total, 320 school administrators and teachers were invited to participate and 247 (77.19%) of them completed the online survey.

Most of the participants were working in the elementary schools ($n = 192$, 77.73%), home classroom teachers ($n = 118$, 47.77%), female ($n = 160$, 64.78%), aged between 40 and 50 years old ($n = 113$, 45.75%), with at least a bachelor degree (bachelor: $n = 117$, 47.37%; graduate: $n = 123$, 49.80%). Furthermore, the majority of them were not working in schools located in remote areas, not working in disaster-stricken-schools, and not personally experiencing disasters. As to the participation of the disaster prevention education program, slightly more than half of them ($n = 146$, 59.11%) actually participated in the program. More details are listed in Table 2.

3.2 Instrument

The online survey consisted of two parts: (1) disaster prevention literacy and (2) background information.

In the first part of the survey, there were 29 items measuring disaster prevention literacy based on the theoretical framework by Sin-Cheng Ye [19] with 8 categories subsumed under 3 dimensions of disaster prevention literacy (Table 1). All survey items were on a 5-point Likert scale (1: strongly disagree; 2 disagree; 3: neutral; 4: agree; 5: strongly agree). Among those 29 items, 11 were adopted from other studies [2, 7, 11, 14, 17, 18, 20] and the remaining 18 were developed according to the aforementioned theoretical framework. All items were reviewed by an expert panel and some items were revised as suggested by the content experts to enhance the content validity of the survey items. Then the survey items were administered to 10 school teachers in a pilot study to assess the item clarity. The Cronbach's alpha coefficients as 0.81 from the results

Table 2 Participant demographics (N = 247).

Variable	n	%
School level		
Elementary school	192	77.73
Middle school	55	22.27
Job Title		
Principal	4	1.62
Director	51	20.65
Section leader	39	15.79
Home classroom teacher	118	47.77
Subject teacher	27	10.93
Staff	8	3.24
Age		
20-29	34	13.77
30-39	75	30.36
40-49	113	45.75
50 or more	25	10.12
Highest education		
Associate	7	2.83
Bachelor	117	47.37
Graduate	123	49.80
Years of service		
< 5	43	17.41
5-14.9	83	33.60
15-24.9	84	34.01
25 and more	37	14.98
School location		
Remote areas	80	32.39
Not remote areas	167	67.61
Personal experiences of disasters		
Yes	102	41.30
No	145	58.70
Working in a disaster-stricken school		
Yes	37	14.98
No	210	85.02
Participation in disaster prevention education program		
Yes	146	59.11
No	101	40.89

in the pilot study suggested a good internal consistency of the survey items [21]. The actual survey is listed in Table 3.

In the second part of the survey, the respondents were asked to answer the questions regarding (1) school level, (2) job title, (3) gender, (4) age, (5) highest education, (6) years of service, (7) school location, (8) personal experiences of disasters, (9) currently working

Table 3 Survey items for different categories of disaster prevention literacy among middle school and elementary school teachers.

Dimension Category	Survey Item
Knowledge	
Disaster knowledge	
	#20 Earthquakes can be predicted by scientific instruments and techniques
	#21 Earthquakes may lead to earth shattering, tsunami, flood, and soil liquefaction
	#22 I can thoroughly explain the reasons why Shao-Lin village was wiped out during a typhoon
Preparedness knowledge	
	#9 I can use the comparison between disaster preparedness in different schools to inform students that disaster preparedness and evacuation planning can alleviate the damages of disasters
	#11 I can compile the disaster prevention materials to be used as the after-school supplements for students.
	#17 I will sometimes skip some disaster prevention procedures due to the repetition of them every year
	#19 I perceive the first-aid kit as being necessary to prevent the disaster occurrence
Response knowledge	
	#7 I can facilitate students to cooperate with the campus disaster response measures and make them understand how to conduct, assist, and wait for the rescues work
	#26 I will help to check the house damages after the disasters.
	#27 I will donate items which people in the disaster-stricken areas need.
Attitude	
Prevention awareness	
	#1 I will inform the building manager once I see the personal belongings in the stairwell or the safety exit
	#3 I will pay attention to the irregularities in the surroundings for the sake of safety of myself and the students
	#4 I will regularly check the safety of the living environment to reduce the disaster-induced damages
	#12 I will explain to the students the causes of casualties upon hearing the disaster news
	#13 I will remind the students to prepare for the typhoon at home prior to the issues of typhoon warning
Prevention values	
	#5 We cannot predict the time and location of disaster occurrence so that we don't need to waste time on disaster preparation
	#6 I will agree that the government should first spend money on the preparation for disaster rehabilitation instead of disaster prevention education
	#15 I will encourage students to discuss together for problem clarification in disaster prevention education
	#24 I will approve the release the information of disaster-prone areas by the government even though it may lead to the fall of housing prices
Prevention sense of responsibility	
	#8 There are disaster shelters at school to place disaster-affected people
	#16 I will assist the planning and organization of community residents to participate in the promotional events of disaster prevention at school
	#28 I am not very clear of the disaster prevention and rescues plan in my own school
Skills	
Preparedness action	
	#2 I should identify the location of the emergency exit and equipment upon entering a public building
	#10 I will help students understand the campus safety map and plan the proper escape routes and placement sites for different classrooms
	#14 I will participate in the planning of regular disaster prevention drill at school to help students understand the escape routes and escape procedures
	#18 I feel bored while the school is mandated to hold the disaster prevention drills repeatedly
Response behaviors	
	#23 While the disaster prevention drill is held in my community, I will cooperate during the evacuation
	#25 Upon the disaster occurrence, I will protect myself and guide the students to behave to avoid the disaster damages
	#29 While the neighboring community is struck by the disaster, I think I can assist the rescues work for disaster-affected people

Note: Survey items #5, #6, #17, #18, and #28 are reversely worded items.

in a disaster-stricken school, and (10) if participate in the Plan for Disaster Prevention and Campus Network Deployment and Experiment or not.

3.3 Operationalization of Independent Variable

The independent variables in the research question 2 were those background variables (i.e., school level, job title, gender, age, highest education, years of service, school location, disaster experiences, and disaster-stricken status of the school). Then the independent variable in the research question 3 was regarding whether a teacher participated in disaster prevention education program entitled the Plan for Disaster Prevention and Campus Network Deployment and Experiment in 2013 or not.

3.4 Measurement of Dependent Variables

In the research question 1, three dimensions and the subsumed eight categories of disaster prevention literacy served as the dependent variable. As to the research questions 2 & 3, three dimensions of disaster prevention literacy are the dependent variables. Those dependent variables were measured by various numbers of survey items (Table 2) on a 5-point Likert scale (1: strongly disagree; 2 disagree; 3: neutral; 4: agree; 5: strongly agree). The average scores from the related survey items would indicate the levels of disaster prevention literacy in 3 dimensions and 8 specific categories.

3.5 Data Analysis

All data analyses were conducted with IBM SPSS Statistics 22.

3.5.1 Research Question 1: Descriptive Statistics

The means and standard deviations were computed for each dimension and category of disaster prevention literacy to address the research question 1.

3.5.2 Research Questions 2 and 3: One-way analysis of variance (ANOVA)

The one-way ANOVA [21, 22] was conducted to assess if various dimensions of disaster prevention

literacy, one at a time, changed across the levels of the independent variable. The F test of the variance related to the independent variable would help to decide if there was a relationship between the participation in the disaster prevention education program and disaster prevention literacy. The alpha level was set at 0.05 for all the F tests in this study. The was computed as an effect size index to estimate the proportion of the variance in the dependent variable accounted for by the independent variable [22].

4. Results

4.1 Research Question 1

Various descriptive statistics of the dependent variables are listed in Table 4. Overall, among three dimensions of disaster prevention literacy, participants had the highest mean score on disaster prevention skills (i.e., 4.50) and the lowest on disaster prevention knowledge (i.e., 4.20). Therefore, participants were strongest on disaster prevention skills but weakest on disaster prevention knowledge.

As to the specific categories under the knowledge dimension of disaster prevention literacy, participants scored the highest, on average, on response knowledge (i.e., 4.39) and the lowest on disaster knowledge (i.e., 3.94). For the attitude dimension of disaster prevention literacy, participants had the highest mean score on disaster awareness category (i.e., 4.47) and the lowest on disaster sense of responsibility category (i.e., 4.10). Under the skills dimension of disaster prevention literacy, participants scored higher on response behaviors (i.e., 4.48) relative to preparation action (i.e., 3.61).

4.2 Research Question 2

With the research question 2, we empirically examined if each dimension of disaster prevention literacy (i.e., knowledge, attitude, & skills) differed by various background characteristics of participants.

Table 4 Descriptive statistics of dimensions and categories of disaster prevention literacy among middle school and elementary school teachers (N = 247).

Variable	<i>M</i>	<i>Mdn</i>	<i>SD</i>	<i>Min.</i>	<i>Max.</i>
Knowledge	4.20	4.30	0.45	3.00	5.00
Disaster knowledge	3.94	4.00	0.62	1.33	5.00
Preparedness knowledge	4.24	4.25	0.55	2.75	5.00
Response knowledge	4.39	4.33	0.56	2.67	5.00
Attitude	4.34	4.42	0.44	3.00	5.00
Prevention awareness	4.47	4.50	0.51	2.75	5.00
Prevention values	4.38	4.50	0.55	2.75	5.00
Prevention sense of responsibility	4.10	4.33	0.69	2.00	5.00
Skills	4.50	4.57	0.48	3.00	5.00
Preparedness action	3.61	3.80	0.40	2.40	4.00
Response behaviors	4.48	4.67	0.56	2.33	5.00

Note: *M*: Mean; *Mdn*: Mode; *SD*: Standard deviation; *Min.*: Lowest result; *Max.*: Highest result.

4.2.1 School Level as the Independent Variable

The results suggested that disaster prevention knowledge, $F(1, 245) = 11.32, P < 0.05, \eta^2 = 0.04$, disaster prevention attitude, $F(1, 245) = 9.59, P < 0.05, \eta^2 = 0.04$, and disaster prevention skills, $F(1, 245) = 18.34, P < 0.05, \eta^2 = 0.04$, changed across school levels (elementary school vs. middle school) of the participants. Furthermore, the elementary school participants were higher than their middle school counterparts on disaster prevention knowledge (4.25 vs. 4.02), disaster prevention attitude (4.38 vs. 4.18), and disaster prevention skills (4.56 vs. 4.26).

4.2.2 Job Title as the Independent Variable

The results did not support the differences in disaster prevention knowledge, $F(5, 241) = 1.56, P > 0.05, \eta^2 = 0.03$, disaster prevention attitude, $F(5, 241) = 1.61, P > 0.05, \eta^2 = 0.03$, and disaster prevention skills, $F(5, 241) = 1.29, P > 0.05, \eta^2 = 0.03$, across the participants with various job titles.

4.2.3 Gender as the Independent Variable

The differences between female participants and the male participants in disaster prevention knowledge, $F(1, 245) = 1.56, P > 0.05, \eta^2 = 0.03$, disaster prevention attitude, $F(1, 245) = 1.61, P > 0.05, \eta^2 = 0.03$, and disaster prevention skills, $F(1, 245) = 1.29, P > 0.05, \eta^2 = 0.03$, were not shown in the results. In terms of actual mean scores on three dimensions of

disaster prevention literacy, they were similar in both gender groups.

4.2.4 Age as the Independent Variable

Three dimensions of disaster prevention literacy, disaster prevention knowledge, $F(3, 243) = 11.89, P < 0.05, \eta^2 = 0.13$, disaster prevention attitude, $F(3, 243) = 11.76, P < 0.05, \eta^2 = 0.13$, and disaster prevention skills, $F(3, 243) = 12.14, P < 0.05, \eta^2 = 0.13$, changed across age groups. Specifically, older participants seemed to be higher in disaster prevention literacy. The mean scores of disaster prevention knowledge were 3.94, 4.06, 4.33, and 4.35 for participants being (1) 20-29 years old, (2) 30-39 years old, (3) 40-49 years old, and (4) 50 years old or older respectively. As to disaster prevention attitude, the mean scores were 4.03, 4.24, 4.46, and 4.46 for different age groups in ascending order. Last, the mean scores of disaster prevention skills were 4.19, 4.37, 4.62, and 4.71 for different age groups in ascending order.

4.2.5 Highest Education as the Independent Variable

According to the results, disaster prevention knowledge, $F(2, 244) = 1.51, P > 0.05, \eta^2 = 0.01$, disaster prevention attitude, $F(2, 244) = 2.10, P > 0.05, \eta^2 = 0.02$, and disaster prevention skills, $F(2, 244) = 0.34, P > 0.05, \eta^2 = 0.003$, disaster prevention literacy was not related to highest education of the participants.

4.2.6 Years of Service as the Independent Variable

Three dimensions of disaster prevention literacy changed across participants of different years of service, disaster prevention knowledge, $F(3, 243) = 7.18, P < 0.05, \eta^2 = 0.08$, disaster prevention attitude, $F(3, 243) = 10.05, P < 0.05, \eta^2 = 0.11$, and disaster prevention skills, $F(3, 243) = 11.05, P < 0.05, \eta^2 = 0.12$. Furthermore, the longer the participants worked as school administrators or school teachers, the higher their disaster prevention literacy would be. The mean scores of disaster prevention knowledge were 3.99, 4.16, 4.23, and 4.43 for participants with the years of service being (1) less than 5 years, (2) 5-14.9 years, (3) 15-24.9 years, and (4) 50 years or more respectively. As to disaster prevention attitude, the mean scores were 4.06, 4.33, 4.39, and 4.55 for groups of different years of service in ascending order. Last, the mean scores of disaster prevention skills were 4.20, 4.46, 4.57, and 4.76 for groups of different years of service in ascending order.

4.2.7 School Location as the Independent Variable

The results suggested that disaster prevention literacy remained the same across participants from schools in remote areas and participants from schools not in remote areas, disaster prevention knowledge, $F(1, 245) = 0.30, P > 0.05, \eta^2 = 0.001$, disaster prevention attitude, $F(1, 245) = 0.33, P > 0.05, \eta^2 = 0.003$, and disaster prevention skills, $F(1, 245) = 0.71, P > 0.05, \eta^2 = 0.003$.

4.2.8 Personal Experiences of Disasters as the Independent Variable

Disaster prevention literacy was found to differ across the participants with personal experience of disasters and the participants with no personal experiences of disasters, disaster prevention knowledge, $F(1, 245) = 7.25, P < 0.05, \eta^2 = 0.03$, disaster prevention attitude, $F(1, 245) = 4.27, P < 0.05, \eta^2 = 0.02$, and disaster prevention skills, $F(1, 245) = 5.96, P < 0.05, \eta^2 = 0.02$. In specific, the participants with personal experiences of disasters had higher disaster prevention literacy relative to their

counterparts with no personal experiences of disasters, though the actual differences were not sizable. The mean scores of disaster prevention knowledge were 4.29 and 4.13 for the participants with and without personal experiences of disaster. As to disaster prevention attitude, the mean scores were 4.40 and 4.29 for those two groups of participants respectively. Then the mean scores of disaster prevention skills were 4.58 and 4.43 for those two groups of participants respectively.

4.2.9 Disaster-stricken Schools as the Independent Variable

The results supported the differences in disaster prevention knowledge, $F(1, 245) = 12.86, P < 0.05, \eta^2 = 0.05$, disaster prevention attitude, $F(1, 245) = 6.56, P < 0.05, \eta^2 = 0.03$, and disaster prevention skills, $F(1, 245) = 14.30, P < 0.05, \eta^2 = 0.06$, across the participants in disaster-stricken schools and the participants not in disaster-stricken schools. Overall, the participants in disaster-stricken schools had higher disaster prevention literacy relative to their counterparts not in disaster-stricken schools. The mean scores were 4.43 and 4.15 on disaster prevention knowledge, 4.50 and 4.31 on disaster prevention attitude, and 4.76 and 4.45 on disaster prevention skills for those two groups of participants respectively.

4.3 Research Question 3

The research question 3 purposed to investigate if each dimension of disaster prevention literacy (i.e., knowledge, attitude, & skills) differed by participation in the disaster prevention education program.

Participation in the disaster prevention education program as the independent variable. Three dimensions of disaster prevention literacy, disaster prevention knowledge, $F(1, 245) = 9.77, P < 0.05, \eta^2 = 0.04$, disaster prevention attitude, $F(1, 245) = 12.36, P < 0.05, \eta^2 = 0.05$, and disaster prevention skills, $F(1, 245) = 6.15, P < 0.05, \eta^2 = 0.02$, differed across the disaster prevention education program participants and their counterparts not participating in

the disaster prevention education program. Specifically, the disaster prevention education program participants had higher disaster prevention literacy relative to the non-participants. The mean scores of disaster prevention knowledge were 4.27 and 4.09 for the program participants and the non-participants respectively. As to disaster prevention attitude, the mean scores were 4.41 and 4.22 for the program participants and non-participants. Last, the mean scores of disaster prevention skills were 4.56 and 4.41 for the program participants and non-participants.

5. Discussions and Recommendations

5.1 Overall Disaster Prevention Literacy

Among the results of three dimensions of disaster prevention literacy, disaster prevention skills were the highest and disaster prevention knowledge was the lowest for participating school teachers and administrators as a whole. While inspecting the results of the specific categories under knowledge dimension of disaster prevention literacy, participants were weak on disaster knowledge relative to preparedness knowledge and response knowledge. Therefore, the dissemination of the knowledge of various disasters seems to be the area to be stressed in future disaster prevention education programs.

Although the participants were strong on disaster prevention skills, they seemed to be lacking in the skills of preparation action relative to other specific categories of disaster prevention literacy. Accordingly, more attention should be paid to the category of preparation action in the design and implementation of future disaster prevention education programs.

5.2 Disaster Prevention Literacy by Background Characteristics

All three dimensions of disaster prevention literacy remained similar across the participants of different job titles, gender, levels of highest education, and school locations. The finding related to gender is

inconsistent with previous research [16]. On the other hand, three dimensions of disaster prevention literacy were found to differ across the participants of various school levels, age, years of service, personal experiences of disasters, and disaster-stricken school status.

Specifically, elementary school administrators and teachers were higher than their middle school counterparts in disaster prevention literacy. It may be worthwhile to investigate the reasons, such as the stronger emphasis on student academic achievement in the middle schools, why middle school administrators and teachers are lagging on disaster prevention literacy in future research. Thereby, the disaster prevention education program can be tailored to accommodate for participants at different school levels.

The older participants with longer years of service at school, working at disaster-stricken schools, and with personal experiences of disasters were found to have higher disaster prevention literacy relative to the younger participants with shorter years of service at school, not working at disaster-stricken schools, and with no personal experiences of disasters. The relationships among those four background variables in the follow-up analysis seem to explain to some extent why the participants with certain characteristics tend to have better disaster prevention literacy. For instance, the older teachers were more likely to have longer years of service, personally encounter the disasters, work at the disaster-stricken schools, and get more sensitive of disaster prevention. But the above finding does highlight the need to offer more opportunities of disaster prevention education to junior teachers at school not only due to their deficit in disaster prevention literacy but also due to their potentially longer service years to come. Moreover, the senior teachers at school can also be incorporated into the future disaster prevention education program as the facilitators or even instructors to tap into their valuable experiences.

5.3 Disaster Prevention Literacy and Disaster Prevention Education Program

The disaster prevention education program participants were found to possess better disaster prevention literacy than their non-participating counterparts. This is an encouraging, though not conclusive, finding regarding the effectiveness of the disaster prevention education program. More research needs to be conducted to establish the effectiveness of the disaster prevention education program with more rigid research designs, like experimental designs, or statistical procedures to ensure the equivalence of the treatments group and the control group, like the propensity score analysis [23].

References

- [1] Verisk, M. 2014. *Natural Hazards Risk Atlas 2014*. Retrieved from <http://maplecroft.com/portfolio/new-analysis/2014/02/19/natural-hazards-risk-atlas-2014/>.
- [2] Chi-Hung, L. 2011. The Study of Learning Effects on Fourth Grade Students by Adopting Problem-based Learning—Using Disaster Precaution Education as an Example.
- [3] Hung-Pin, H. 2009. “The Typhoon Morakot Disaster and Disaster Reduction Education.” *Journal of Chinese Soil and Water Conservation* 40 (4): 339-43.
- [4] Yi-Hsiu, L. 2010. The Implementation and Effectiveness of the Civic-Action Approach Curriculum on Disaster-Prevention Education from a Global Perspective: An Exemplary Program of “Whirling with Typhoons”.
- [5] Ming-Yang, H. and Chin-Wen, Y. 2010. Fire-prevention Concepts and Attitudes of the 5th and 6th Graders in Elementary Schools of Taipei.
- [6] Jyh-Shi, T. 2002. The Elementary School Teachers’ Attitudes and Behaviors toward Disaster Prevention in Taichung Area Taiwan.
- [7] Sin-Cheng, Y. 2010. Survey on disaster prevention and safe living culture literacy of school teachers and students in Taiwan. The Implementation and Introspection of Technological Disaster Prevention Education and Subsoil Experiment Research and Development Programs.
- [8] Ministry of Justice, Taiwan 2012. *Disaster Prevention and Protection Act*. Retrieved from <http://law.moj.gov.tw/Eng/LawClass/LawContent.aspx?PCODE=D0120014>.
- [9] Yao-Jen, W. 2007. An Investigative Study of Disaster Prevention Literacy for Junior High and Elementary School Students in Taiwan.
- [10] Hsiu-Mei, L. 2001. A Study of Seismic Hazard Mitigation Teaching in Junior High Schools. Master Program of Geography, National Taiwan University, Master’s thesis.
- [11] Yen-Lan, H. 2012. A Study on Disaster Prevention Literacy and Teacher Training Curriculum for Compulsory School Teachers: A Case Study of Nantou County.
- [12] United Nations Educational, Scientific and Cultural Organization (UNESCO) 2005. Aspect of literacy assessment: Topics and issues from the UNESCO expert meeting, Paris, France. Retrieved from <http://unesdoc.unesco.org/images/0014/001401/140125eo.pdf>.
- [13] Chiang, W. J. 2008. Man Made Disaster Prevention Literacy Research of the Fifth Grade Students in Taiwan.
- [14] Li-Chuan, L. 2005. A Study of Teacher’s Belief and Teaching Behavior in Natural Disaster Prevention for Teachers of Southern Area Elementary Schools.
- [15] Kuo-Cheng, C. 1996. A Study of Environmental Knowledge, Attitude and Educational Needs among Students of Public Vocational Training Centers.
- [16] Chen-Ming, L. 2008. A Study of Teacher’s Disaster Prevention Equipment in the Typhoon and Rainstorm for Teachers of Northern Area Elementary Schools.
- [17] Ying-Yan, L. 2008. The Primary and Secondary School Teachers’ Conceptions of Natural Disasters in Taichung City.
- [18] Yang, T. Y. 2010. Research of Vocational School Enforcement with Regard to Disaster Precaution Education—the Dunxu High School of Industry and Commerce in Taipei City as an Example.
- [19] Ye, S. C. 2010. The Implementation and Introspection of Technological Disaster Prevention Education and Subsoil Experiment Research and Development Programs.
- [20] Syu, Y. E. 2001. The Research of Earthquake Preparation Education in Junior High School of Taipei City.
- [21] Norusis, M. J. 2012. IBM SPSS Statistics 19 Statistical Procedures Companion. Upper Saddle River, NJ: Prentice Hall.
- [22] Gamst, G., Meyers, L. S., and Guarino, A. J. 2008. Analysis of Variance Designs: A Conceptual and Computational Approach with SPSS and SAS. New York, NY: Cambridge University Press.
- [23] Guo, S., and Fraser, M. W. 2015. Propensity Score Analysis: Statistical Methods and Applications (2nd ed.), Thousand Oaks, CA: Sage Publications.
- [24] United Nations Office for Disaster Risk Reduction (UNISDR) 2009. 2009 UNISDR Terminology on Disaster Risk Reduction. Retrieved from http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf.