



**An impact evaluation of ShakeOut, an earthquake  
and tsunami drill in two coastal Washington state  
school districts**

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## CONTENTS

<b>ABSTRACT.....</b>	<b>ii</b>
<b>KEYWORDS .....</b>	<b>ii</b>
<b>1.0 INTRODUCTION .....</b>	<b>1</b>
<b>2.0 METHODOLOGY .....</b>	<b>4</b>
<b>3.0 PARTICIPANTS .....</b>	<b>5</b>
<b>4.0 QUESTIONNAIRES .....</b>	<b>7</b>
<b>5.0 PROCEDURE.....</b>	<b>8</b>
<b>6.0 RESULTS.....</b>	<b>9</b>
<b>7.0 TEACHER SURVEY RESULTS.....</b>	<b>23</b>
<b>8.0 FINDINGS AND DISCUSSION .....</b>	<b>28</b>
8.1 Strengths of current school-based disaster drills and education .....	28
8.2 Areas of improvement .....	29
8.3 Other findings .....	30
<b>9.0 LESSONS.....</b>	<b>31</b>
<b>10.0 STUDY LIMITATIONS.....</b>	<b>33</b>
<b>11.0 CONCLUSIONS .....</b>	<b>34</b>
<b>12.0 ACKNOWLEDGEMENTS .....</b>	<b>35</b>
<b>13.0 REFERENCES .....</b>	<b>35</b>

## TABLES

<b>Table 5.1</b>	<b>Participants by School District and Grade.....</b>	<b>8</b>
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## **ABSTRACT**

In October 2012, Washington state participated for the first time in ShakeOut, an annual, one-day event that aims to inform the public about earthquake and tsunami preparedness and encourage residents to simultaneously practice “Drop, Cover and Hold On,” the recommended protective action during an earthquake. The aim of this evaluation was to see how well children in grades six through 12 in two coastal Washington state school districts understood the objectives and consequences of the protective actions practiced during the ShakeOut drill, including a practice of vertical evacuation inside the schools. Across both school districts, 29 teachers volunteered to participate and administered pretest and posttest questionnaires to 574 students, age 10 and older, in order to assess differences in students’ knowledge, skills and attitudes about disaster preparedness and protective actions as a result of participating in the ShakeOut drill. The evaluation found that students had high levels of familiarity and correct knowledge about key protective actions for earthquakes and tsunami before ShakeOut, indicating that previous education and disaster drills in these two school districts have been effective in raising and maintaining children’s awareness of what to do during these disasters. However, for several questions regarding the causes of injury there was no significant improvement in knowledge due to ShakeOut, and significant portions of students had difficulty applying what they have practiced in the classroom to situations outside the classroom. Also, more than a quarter of students in both school districts did not know or were not sure if they participated a tsunami evacuation drill during ShakeOut. These results indicate that school-based disaster drills should be complemented with additional classroom lessons and discussion.

## **KEYWORDS**

ShakeOut, earthquake, tsunami, public education

## 1.0 INTRODUCTION

Children have an increased risk of injury and death during and following disasters, including earthquakes and tsunamis (Peek, 2008). In recent years new initiatives in public policy have focused on strategies to increase the preparedness of children, youth and families (National Commission on Children and Disasters, 2010). Several scholars contend that children can be taught self-protective actions for disasters (Peek, 2008; Ronan & Johnston, 2003, 2005; Slovic et al., 1981), and many organizations and government administrations support the premise that disaster preparedness skills should be taught to children (United Nations International Strategy for Disaster Reduction [UNISDR], 2007; Citizen Corps, 2010). Still, very few school districts in the United States include disaster preparedness education in their kindergarten to grade 12 (K-12) curriculums (Federal Emergency Management Agency, 2010). Where hazards education does exist, the content tends to focus on geophysical events and not the physical and societal consequences of disasters (Mitchell, 2009).

Many school districts do however practice routine fire drills, and in some areas of the country, school districts hold drills for staff and students to practice emergency response procedures for earthquakes and tsunamis, along with other disasters (U.S. Government Accountability Office, 2007). Because hazards education is not required, for many children in the United States, disaster drills serve as the only form of disaster preparedness education they receive in school.

In 2012, Washington state participated for the first time in ShakeOut, an annual, one-day event that aims to inform the public about earthquake preparedness and encourage residents to simultaneously practice “Drop, Cover and Hold On,” the recommended protective action in the event of an earthquake (Southern California Earthquake Center, n.d.). According to the Earthquake Country Alliance (n.d.), “Drop, Cover and Hold On” is an abbreviation for the recommendation to drop down onto your hands and knees, cover your head and neck under a sturdy table or desk, and hold on to your shelter (or to your head and neck) until the shaking stops. ShakeOut was designed by the Earthquake Country Alliance and initiated in California in 2008, and is now organized in many other seismically-active areas, including several U.S. states and regions, New Zealand, Guam, southern Italy and Japan. ShakeOut is promoted on a central website, where information is provided about earthquake preparedness and protective actions, and people are encouraged to register and pledge their participation to take part in the ShakeOut earthquake drill on a designated date and time in their region. ShakeOut has also been used in some communities as an opportunity to learn about and practice protective actions for tsunamis (O’Sullivan, 2012).

According to the *Washington State Enhanced Hazard Mitigation Plan* (Washington Military Department - Emergency Management Division [EMD], 2010), Washington state has experienced approximately 20 damaging earthquake events over the last 125 years. Adjacent to the Cascadia subduction zone, the fault boundary between the North American plate and the Juan de Fuca plate, Washington’s western coastline is particularly vulnerable to earthquakes and tsunamis caused by the sudden displacement of the sea floor (EMD, 2010; Calgue & Orwin, 2005). The only significant earthquake in Washington in the last 20 years was the 2001 Nisqually earthquake, a 6.8 magnitude earthquake with an epicenter ten miles northeast of Olympia, which resulted in some property damage and approximately 700 injuries and one death by heart attack (EMD, 2010).

Although Washington schools are required by state law to conduct regular fire evacuation drills in accordance with the state fire code (Wash. Rev. Code Ann., 2002), they are only encouraged to conduct drills for earthquakes, tsunami, or other high-risk local events (School Safety Planning Manual, 2008). There are also no government or school district-level requirements to teach disaster preparedness in classrooms despite research that has found generally low and, at best, variable levels of risk perceptions and preparedness for earthquakes and tsunami in households and residents across Washington state. Johnston et al. (2005) surveyed 300 residents along Washington's west coast in 2001 and assessed respondents' level of preparedness to deal with tsunami hazards moderate to low. A more recent study by Johnston, Orchiston & Becker (2012) surveying eastern Washington residents found that while respondents were generally aware of the potential for damaging earthquakes in Washington state, few had taken measures to adopt earthquake-specific mitigation measures to protect their property. Also, most survey respondents had rarely or never participated in community activities or events related to earthquake preparedness.

Two coastal Washington state school districts, North Beach School District in Ocean City, WA, and Ocosta School District in Westport, WA, volunteered to participate in the Washington state-wide ShakeOut drill at 10:18am on October 18, 2012. Both school districts serve a rural, K-12 student population of approximately 600 students, and each school district has a single campus that includes one to two school buildings located in a low-lying coastal area. During ShakeOut, each school district facilitated a school-wide earthquake drill, when students and staff practiced "Drop, Cover and Hold On" in their classrooms, followed by a tsunami drill, when students and staff practiced moving to the highest building floor on the school campus. These school districts practice vertical evacuation to prepare for tsunami with a warning of a tsunami arriving in 30 minutes or less (*North Beach School District Tsunami Plan*, 2005).

The aim of this evaluation was to see how well children understood the objectives and consequences of the protective actions they practiced during the ShakeOut drill. This research adds to the growing body of evidence on the effectiveness of the ShakeOut drills in increasing people's knowledge and demonstration of protective actions for earthquakes (Central U.S. Earthquake Consortium, 2011; Petal, Green, Wood, Reuss, & Nguyen, 2011; Green & Petal, 2010; Petal, & Green, R, 2008). Ronan and Johnston (2010) found that drills that provide children the opportunity to repeatedly practice skills and receive constructive feedback help them improve their self-confidence and resiliency, and mitigate injuries when a disaster occurs.

For logistical reasons, school-based earthquake drills are often conducted in a relatively uniform manner at expected times and locations, typically in the middle of class periods when children are at their desks (Ramirez, Kubicek, Peek-Asa & Wong, 2009; Central U.S. Earthquake Consortium, 2011; Johnson, 2011). Therefore, school-based disaster drills can be considered a form of behaviour-based rote learning. Rote learning is a learning technique that emphasizes memorization for the mastery of foundational knowledge, but does not provide the reasoning or relationships involved in the subject that would support knowledge transfer, the ability to use what is learned to solve new problems (Mayer, 2002).

While drills may improve children's emergency response for disasters that occur while they are in school, there is limited research on whether school-based drills prepare children and school staff for unexpected disaster scenarios outside of school (Ramirez et al., 2009). Children who participate in school-based earthquake drills are normally taught to practice "Drop, Cover and Hold On" inside during the school day, but they are not necessarily taught the causes of injury during an earthquake or tsunami and actions to avoid like running outside during ground shaking. Also, drills often do not take into account people's reactions during emergencies (Ramirez et al., 2009). If a goal of these drills is to reduce injuries during an earthquake, an impact evaluation should also assess how effective drills are at developing accurate risk perceptions and problem-solving skills that children can apply during disasters that happen outside the familiar classroom setting or more realistic scenarios at school, such as drills at unexpected times (Green & Petal, 2010).



## **2.0 METHODOLOGY**

The purpose of this study was to evaluate the effectiveness of ShakeOut in improving children's comprehension of risks that cause injuries during disasters, and their knowledge of both correct and incorrect actions during an earthquake or tsunami that could occur while children are inside school, at home or outside. The evaluation was designed using pretest-posttest questionnaires in order to assess differences in knowledge, skills and attitudes about disaster preparedness and protective actions as a direct result of the ShakeOut drill.

The ShakeOut event at North Beach and Ocosta school districts in coastal Washington state consisted of a school-wide "Drop, Cover and Hold On" drill at 10:18am on October 18, 2012 when children were in their third period classrooms, immediately followed by a tsunami drill, which involved evacuating all students and staff from their classrooms to the highest floor of each district's main school building. Students and staff were informed of the drills in advance. Both school districts conduct school-wide earthquake and tsunami drills biannually, so while the school drills' timing with the state-wide ShakeOut event was new, these drills are a familiar practice for the schools' students and staff. Although teachers are encouraged by their school principals to teach earthquake and tsunami science and preparedness to their students, there are no school- or district-wide requirements to teach these subjects in addition to or as an integrated topic in the required curriculum, and there was no requirement to do this as part of the schools' participation in ShakeOut.

### 3.0 PARTICIPANTS

The junior and senior high schools in the North Beach School District and Ocosta School District, both located in Gray's Harbor County, WA, were purposively chosen for the study because these schools districts had both an earthquake and tsunami risk and had volunteered to conduct an earthquake and tsunami drill during ShakeOut on October 18, 2012. Also, the Gray's Harbor County emergency manager volunteered to provide communications and logistical support during the course of the evaluation, which was critical to the execution of this study. Because a quantitative, written questionnaire was chosen as the most feasible data collection tool, the study participants were limited to students enrolled in the school districts' junior and senior high schools (grades six through 12), which teach children age ten and older. Bell (2007) provides evidence that questionnaire research is feasible with children age seven and older.

Twenty-nine teachers of grades six through 12 in Ocosta School District and grades seven through 12 in North Beach School District were asked to volunteer to participate and administer the pre- and post-ShakeOut questionnaires to their third period students, the class period when the ShakeOut drills would take place on October 18, 2012.

The evaluation received responses from 574 students, a 92 percent response rate from the total sample of 624 students. North Beach School District received 291 responses from its student population of 318 in grades seven to 12, resulting in a 91.5 percent response rate. Ocosta School District received 283 responses from its student population of 306 in grades six to 12, resulting in a 92 percent response rate.<sup>1</sup>

Of the 574 participants, 74 percent completed a pre- and post-ShakeOut questionnaire (n=428), 12 percent completed a pre-ShakeOut questionnaire only (n=67) and 14 percent completed a post-ShakeOut questionnaire only (n=79). Consequently, there were a total of 495 completed pretests and 507 completed posttests.

All of the 29 participating teachers in both school districts completed a post-ShakeOut teacher survey. The results of this survey revealed that 12 of the teachers reviewed the correct answers to the student questionnaire after students completed the pretest and before the posttest. Twelve teachers did not review the correct answers with students before the posttest and five teachers indicated they did not administer a posttest to students or could not remember if or when they reviewed the answers. With this information, student responses were broken into two groups to compare the responses of students who reviewed the correct answers before the posttest (n=263) to who did not review the answers before the posttest (n=225). The responses of students whose teachers did not clearly indicate if and when a review was done were excluded from the subgroups (n=86).

North Beach School District located in Ocean City, WA is rural, coastal public school district comprised of two elementary schools, one junior high school and one senior high school serving a region of 6,566 residents; residents aged ten to 19 make up 7.8 percent of this population (*Washington School District Demographic Profiles*, 2009). According to the *Washington State Report Card (n.d.)*, as of May 2012 the North Beach Junior and Senior

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<sup>1</sup> The school district Superintendents provided the schools' student population counts in October 2012 to the author by email.

High Schools, including grades seven through 12, served 333 students, including 29 special education students. Within this population, 72.4 percent of students are White, 10.4 percent are American Indian or Alaskan Native, 7.0 percent are Hispanic, and the remaining are identified as some other race with less than five percent in each category. As of May 2012, 68.4 percent of students were eligible for free or reduced-price meals.

Ocosta School District located in Westport, WA is a rural, coastal public school district comprised of one elementary school and one junior-senior high school serving a region of 7,948 residents; residents aged ten to 19 make up 10.6 percent of the this population (*Washington School District Demographic Profiles*, 2009). According to the *Washington State Report Card*, as of May 2012 the Ocosta Junior-Senior High School, including grades six through 12, served 281 students, including 42 special education students. Within this population, 68.9 percent are White, 15.8 percent are Hispanic, 7.9 percent are two or more races and 5.4 percent are American Indian or Alaskan Native; the remaining are identified as some other race with less than two percent in each category. As of May 2012, 69.5 percent of students were eligible for free or reduced-price meals.

## 4.0 QUESTIONNAIRES

Written questionnaires for students and the participating teachers respectively were used to collect data because the tools are low cost, create minimal classroom disruption and could be administered to a large number of classrooms simultaneously. Also, considering children's potential sensitivity to the topics in the questionnaires and the aim of a high response rate, it was ideal for the students' teachers to administer the questionnaires, and permission was obtained from the school district Superintendents for the study investigator to recruit teachers as volunteer survey administrators for the evaluation.

Bell (2007) provides evidence that survey research can be effectively conducted with children age seven and older, and if adapted and age-appropriate, quantitative questionnaires can yield results that are valid (i.e. accurately reflecting the intention of the question) and reliable (i.e. replicable using a similar survey). For the purpose of this study, the student questionnaires were shortened and simplified as much as possible and were written at a 6<sup>th</sup> grade reading level. The student pretest included 12 single select and multiple-choice questions, and the posttest questionnaire comprised 15 questions, including the 12 original questions. The last question in the posttest comprised four statements that requested a response using a Likert scale of one to four.

The student questionnaires were designed to assess children's knowledge, risk perceptions, and application of their knowledge and risk perceptions in theoretical situations. The questions examined students' knowledge and perceptions of: 1) protective actions for earthquakes and tsunami, 2) actions they should take and actions to avoid during earthquakes and tsunami when inside and outside buildings, 3) the causes of injury during earthquakes, and 4) what "Drop, Cover and Hold On" means and why this action is practiced. They were also asked questions about their exposure to education on disaster preparedness, their individual actions during the ShakeOut drill, their degree of upset feelings when thinking or talking about disasters, what they intend to do if an earthquake happens while they are at home, and their perception of how much they knew about earthquake and tsunami preparedness before and after ShakeOut.

Teachers were also provided an eight question post-ShakeOut questionnaire that gathered information about their experience and classroom activities. The results of this questionnaire provided additional information on how much exposure students had to earthquake and tsunami-related classroom lessons just before, during and after ShakeOut, as well as students' exposure to a review of the correct answer key and explanations for the student questionnaire, which were provided to teachers before the evaluation began. Teachers were also asked their feelings when discussing or thinking about earthquakes and tsunami, and their opinion on the frequency of school disaster drills.

## 5.0 PROCEDURE

Several weeks before the evaluation began teachers and parents were provided informational materials and an opportunity to attend an in-person information meeting at each of the schools to learn more about the evaluation, the ShakeOut drills, and general information about earthquake and tsunami preparedness. Teachers, students and students' parents were informed of their right to decline participation in the evaluation, and parents of children age 15 and younger could indicate their non-consent of their child's participation in the evaluation through a non-consent form provided to them.

The student pretest was administered to students during their third period classroom during the first week of October 2012. The ShakeOut drill took place on Thursday, October 18, 2012 at 10:18am, during the schools' third period classes, and the student posttest was administered to the classrooms the following week. In advance of the evaluation, each teacher was provided a packet containing paper copies of the pre- and post-ShakeOut student questionnaires, information and instructions for the administration of the questionnaires, instructions to be read aloud to students before each test, a correct answer key with explanations of the correct and incorrect answers, and the post-ShakeOut teacher questionnaire.

On the student questionnaire cover page, students were asked to write their name, age, teacher's name and grade level. After the completed pretests and posttests were collected, they were paired by the student and teacher names. Before data analysis began the cover pages were removed and the survey sets were marked with a unique number. The data were entered into an online survey form by the lead investigator and analyzed. Questions that had no response, or had a contradictory response (e.g. more than one answer selected for a question requiring a single response), were not added to the analysis. These types of responses are counted as "skipped" in the results.

**Table 5.1** Participants by School District and Grade.

School district and Grade	Response rate	Total by Grade
Ocosta Grade 6	10.8% (62)	11% (62)
North Beach Grade 7	8.0% (46)	15% (87)
Ocosta Grade 7	7.1% (41)	
North Beach Grade 8	10.3% (59)	16% (91)
Ocosta Grade 8	5.6% (32)	
North Beach Grade 9	9.4% (54)	18% (105)
Ocosta Grade 9	8.9% (51)	
North Beach Grade 10	8.9% (51)	16% (90)
Ocosta Grade 10	6.8% (39)	
North Beach Grade 11	6.6% (38)	14% (80)
Ocosta Grade 11	7.3% (42)	
North Beach Grade 12	7.5% (43)	10% (59)
Ocosta Grade 12	2.8% (16)	
<b>Total</b>		<b>574</b>

## 6.0 RESULTS

Percentage changes highlighted in red are those that represent a five percent change or greater. Also, rows in the tables in color highlight correct answers. Where applicable, rows without colour represent incorrect answers.

***Have you learned about what to do to prepare for earthquakes that can happen in Washington State?***

Response	Pretest	Posttest	%Change
Yes	86.5% (424)	85.5% (432)	-1.0%
No	4.7% (23)	6.1% (31)	+1.4%
Not sure	8.8% (43)	8.3% (32)	-0.5%
Total	490	505	
Skipped	5	2	

***If yes, please indicate where you learned about what to do to prepare for earthquakes (select all that apply):***

Responses	Pretest	Posttest	%Change
At school	97.7% (416)	96.8% (423)	-0.9%
At home	32.9% (141)	37.5% (164)	+4.6%
Boy Scouts / Girl Scouts	7.0% (30)	6.2% (29)	-0.8%
Summer camp	3.3% (14)	3.9% (17)	-0.6%
Other (please specify)*	5.8% (25)	6.2% (27)	-0.4%
Total	429	437	

*\*Other Pretest*

Common Sense (6)  
 TV / Internet / Books (3)  
 Museum / Tribal Center (3)  
 Fire Department (3)  
 None indicated (2)  
 Friend (2)  
 Church (1)  
 Day Care (1)  
 Experienced an earthquake (1)

*Other Posttest*

TV / Internet / Books (7)  
 None indicated (4)  
 Common Sense (2)  
 Museum/Tribal Center (2)  
 Church (2)  
 Friend (1)  
 Day Care (1)

Before ShakeOut, a high percentage of students indicated that they had learned about earthquake preparedness, and this percentage did not change significantly after ShakeOut. After ShakeOut, a portion of students (14.4%) indicated they have not learned or are not sure if they have learned about earthquake preparedness. Children's understanding and definition of earthquake preparedness likely varies.

The results indicate that most children who had learned about earthquake preparedness learned this at school. Only about a third of respondents indicated that they learned about earthquake preparedness at home, and this percentage was higher after ShakeOut.

A smaller percentage of respondents indicated that they learned about earthquake preparedness in other outside-school activities like Boy Scouts and Girl Scouts, and summer camp. One limitation to these results is potential memory bias.

***If you hear the words “Drop, Cover and Hold On”, what would you do? (pick one)***

Responses	Pre	Post	%Change
Drop to the ground, take cover under a desk or table if nearby, hold on to the desk or table until the shaking stops	96.9% (476)	96.0% (485)	-0.9%
Drop what you are doing, cover your ears, hold on to your belongings	0.8% (4)	2.0% (10)	+1.2%
Drop what you are doing, run for cover, hold on to your belongings	0.6% (3)	0.6% (3)	0%
None of the above	0.8% (4)	0.8% (4)	0%
I don't know	0.8% (4)	0.6% (3)	-0.2%
Answered Question	491	505	
Skipped	4	2	

Before ShakeOut, the vast majority of students picked the correct answer for the meaning of “Drop, Cover and Hold On.” Only a very small percentage of students selected an incorrect answer or ‘I don’t know’ before and after ShakeOut.

***Why do you “Drop, Cover and Hold On” during an earthquake? (select all that apply)***

Responses	Pretest	Posttest	%Change
To protect myself from flying objects	96.1% (471)	96.4% (479)	+0.3%
To prevent myself from falling	20.8% (102)	20.1% (100)	-0.7%
To stay warm	0.4% (2)	1.4% (7)	+1.0%
To protect my ears from loud noises	4.3% (21)	3.0% (15)	-1.3%
To prevent fainting and heart attacks	5.7% (28)	6.8% (34)	+1.1%
I don't know	2.2% (11)	1.6% (8)	-0.6%
Answered Question	490	497	
Skipped	5	10	

The vast majority of participants correctly identified that “Drop, Cover and Hold On” helps protect them from flying objects. However, only a fifth of participants identified “Drop, Cover and Hold On” as preventing falling during both the pretest and posttest. For this question, there were no significant changes in the results after ShakeOut.

***If an earthquake happened while you are inside a building, there are couple different things you could do that would help protect you from injuries. Check Yes, No or Not Sure for each possible action during an earthquake.***

***Go outside to an open area***

Responses	Pretest	Posttest	%Change
No	41.8% (201)	57.5% (281)	+15.7%
Yes	38.5% (185)	28.6% (140)	- 9.9%
Not sure	19.8% (95)	13.9% (68)	- 5.9%
Total	481	489	
Skipped	14	18	

***Reviewed Answers After Pretest***

***Did Not Review Answers***

Reviewed Correct Answers				Did Not Review Correct Answers		
Responses	Pre	Post	%Change	Pre	Post	%Change
No	43.6% (95)	62.9% (139)	+19.3%	40.8% (75)	51.3% (97)	+10.5%
Yes	36.2% (79)	24.9% (55)	- 11.3%	38.6% (71)	36.0% (68)	-2.6%
Not sure	20.2% (44)	12.2% (27)	- 8.0%	20.7% (38)	12.7% (24)	-8.0%
Total	218	221		184	189	

In results from the pretest, less than half the students chose the correct answer ‘No.’ An almost equal number of students indicated it would be protective to go outside during an earthquake and almost a fifth of the students responded ‘Not sure.’ During the posttest, the proportion of correct answers increased by 15.7 percent and the proportion of the incorrect answer ‘Yes’ decreased by 9.9 percent, and ‘Not sure’ decreased by 5.9 percent. Classrooms who reviewed the correct answers after the pretest had a higher proportion of correct answers and lower proportion of incorrect answers during the posttest compared to the classrooms that had not reviewed the correct answers.

Another explanation for the change in proportions of correct and incorrect answers may be confusion about the question. During earthquake drills, many schools practice evacuating students and staff outside to an open area after conducting a “Drop, Cover and Hold On” drill in the classroom. Therefore, some children may have understood this question to concern a protective action taken after the shaking has ended, not an action during shaking as the question intended.

It is relevant to note that during the October 18, 2012 ShakeOut drills in both the North Beach and Ocosta School Districts, the participating classrooms immediately evacuated to the top floor of the highest building after they practiced “Drop, Cover and Hold On” in classrooms, and therefore none of questionnaire respondents went outside during the drills.



***Hold on to a desk and try to stay standing***

Responses	Pretest	Posttest	%Change
No	90.4% (434)	87.6% (423)	-2.8%
Yes	5.4% (26)	10.4% (50)	+5.0%
Not sure	4.2% (20)	2.1% (10)	-2.1%
Total	480	483	
Skipped	15	24	

***Reviewed Answers After Pretest***

***Did Not Review Answers***

Responses	Pretest	Posttest	%Change	Pretest	Posttest	%Change
No	89.8% (193)	88.6% (194)	-1.2%	88.7% (165)	84.3% (156)	-4.4%
Yes	4.7% (10)	10.0% (22)	+5.3%	7.5% (14)	11.9% (22)	+4.4%
Not sure	5.6% (12)	1.4% (3)	-4.2%	3.8% (7)	3.8% (7)	0%
Total	215	219		186	185	

The vast majority of respondents chose the correct answer 'No' on both the pretests and posttests. A small percentage of respondents answered incorrectly or chose 'Not sure'. Surprisingly the proportion of those incorrectly responding 'Yes' increased during the posttest, both in the classrooms that reviewed the correct answers and those that did not.

***Drop to my knees and cover my head and neck***

Responses	Pretest	Posttest	%Change
Yes	77.7% (373)	88.6% (434)	+10.9%
No	12.9% (62)	4.9% (24)	-8.0%
Not sure	9.4% (45)	6.5% (32)	-2.9%
Total	480	490	
Skipped	15	17	

***Reviewed Answers After Pretest***

***Did Not Review Answers***

Responses	Pretest	Posttest	%Change	Pretest	Posttest	%Change
No	77.4% (168)	90.1% (200)	+12.7%	77.7% (143)	86.5% (166)	+8.8%
No	12.4% (27)	4.1% (9)	-8.3%	14.1% (26)	6.3% (12)	-7.8%
Not sure	10.1% (22)	5.9% (13)	-4.2%	8.2% (15)	7.3% (14)	-0.9%
Total	217	222		184	192	

The majority of student correctly answered 'Yes' to this question on both the pretests and posttests. On the posttest, the percentage of correct answers increased, and incorrect and 'Not sure' answers decreased. Both students who reviewed the correct answers and those that did not both had an increase in the percentage of correct answers after ShakeOut.

### **Go to a doorway**

<b>Responses</b>	<b>Pretest</b>	<b>Posttest</b>	<b>%Change</b>
No	24.7%(119)	23.4%(115)	-1.3%
Yes	67.2% (324)	65.8% (323)	-1.4%
Not sure	8.1% (39)	10.8% (53)	+2.7%
Total	482	491	
Skipped	13	16	

According to the ShakeOut website, going to a doorway is an unsafe action during an earthquake. Approximately two-thirds of students chose 'Yes', indicating 'Go to a doorway' would be a protective action. There was only a very small percentage change in results for both the correct and incorrect answers from the pretest to posttest, even among the group of students who reviewed the correct answers after the pretest, indicating that ShakeOut had no impact on children's understanding of current emergency management advice to not shelter in a doorway during an earthquake.

### **Take cover under a desk or table if possible**

<b>Responses</b>	<b>Pretest</b>	<b>Posttest</b>	<b>%Change</b>
Yes	97.3% (471)	97.4% (484)	+0.1%
No	0.8% (4)	1.0% (5)	+0.2%
Not sure	1.9% (9)	1.6% (8)	-0.3%
Total	484	497	
Skipped	11	10	

The pretests indicate that there was a high level of correct knowledge about taking cover under a desk or table before ShakeOut.

### **Get next to a desk to create a "triangle of life"**

<b>Responses</b>	<b>Pretest</b>	<b>Posttest</b>	<b>%Change</b>
No	47.7% (227)	46.0% (223)	-1.7%
Yes	10.1% (48)	19.0% (92)	+8.9%
Not sure	42.2% (201)	35.1% (170)	-7.1%
Total	476	485	
Skipped	19	22	

### **Reviewed Answers After Pretest**

### **Did Not Review Answers**

<b>Responses</b>	<b>Pretest</b>	<b>Posttest</b>	<b>%Change</b>	<b>Pretest</b>	<b>Posttest</b>	<b>%Change</b>
No	46.4% (98)	47.5% (105)	+1.1%	51.1% (95)	45.4% (84)	-5.7%
Yes	12.8% (27)	21.7% (48)	+8.9%	9.1% (17)	18.9% (35)	+9.8%
Not sure	40.8% (86)	30.8% (68)	-10.0%	39.8% (74)	35.7% (66)	-4.1%
Total	211	221		186	185	

In March 2011, local and state emergency management officials in Washington responded to a media report that the unofficial “Triangle of Life” advisement had been circulating on the Internet (Haeck, 2011 March 31). The “Triangle of Life” is a confuted theory promoted through viral email messages that advocates for sheltering next to solid objects and not under tables during earthquakes as advised by most national and international emergency management organizations (Southern California Earthquake Center, n.d.).

Less than half of students correctly answered ‘No’ before ShakeOut, and there was no increase in the percentage of correct answers after ShakeOut. A large percentage of students answered ‘Not sure’ on the pretests and posttests, indicating that the students’ familiarity with the “Triangle of Life” theory is low. After ShakeOut, there was a larger percentage of students incorrectly answering ‘Yes’, including among those students who reviewed the correct answers and explanations after the pretest. In sum, more than half of the students do not seem to be able to apply their knowledge and practice of “Drop, Cover and Hold On” to come to the conclusion that getting next to a desk is incorrect. However, the student responses to this question may have been impacted by misunderstanding of the term “Triangle of Life” and confusion about the question.

***What would be the best thing to do if you are inside but don’t have a desk or table near you during an earthquake? (pick one)***

Responses	Pretest	Posttest	%Change
Drop to my knees and cover my head and neck	60.7% (287)	66.0% (322)	+5.3%
Go to another room to find a desk or table to cover under	14.0% (66)	16.4% (80)	+2.4%
Go outside to an open area	16.1% (76)	9.2% (45)	-6.9%
Find an adult	2.3% (11)	3.3% (16)	+1.0%
Incorrect answers total:	32.4%	28.9%	-3.5%
I don’t know	7.0% (33)	5.1% (25)	-1.9%
Answered Question	473	488	
Skipped	22	17	

***Reviewed Answers After Pretest***

***Did Not Review Answers***

Responses	Pretest	Posttest	%Change	Pretest	Posttest	%Change
Drop to my knees	60.5% (127)	66.1% (144)	+5.6%	58.4% (108)	60.1% (116)	+1.7%
Go to another room	13.8% (29)	18.8% (41)	+5.0%	16.2% (30)	18.1% (35)	+1.9%
Go outside	14.8% (31)	8.3% (18)	-6.5%	17.3% (32)	11.4% (22)	-5.9%
Find an adult	3.3% (7)	3.2% (7)	-0.1%	2.2% (4)	2.6% (5)	+0.4%
Incorrect answers	31.9% (67)	30.3% (66)	-1.6%	35.7% (66)	32.1% (62)	-3.6%
I don’t know	7.6% (16)	3.7% (8)	-3.9%	5.9% (11)	7.7% (15)	+1.8%
Total	210	218		185	193	

The correct answer to this question is “Drop to my knees and cover my head and neck.” The percentage of student choosing this correct response increased 5.3 percent from the pretest to the posttest. While the percentage of incorrect answers decreased after ShakeOut, in the posttest 28.9 percent of students chose an incorrect answer and 5.1 percent students chose ‘I don’t know.’ Students who reviewed the correct answers had mixed results: the percentage of correct answers increased, however a larger percentage of students in this group also chose “Go to another room to find a desk or table to cover under,” indicating that review of the correct answers was not particularly effective in improving knowledge for this question.

***What do you think has caused the most injuries during earthquakes in the United States? (pick one)***

Responses	Pretest	Posttest	%Change
Flying objects and broken glass	51.7%(237)	58.8% (283)	+7.1%
Building collapse	34.5% (158)	30.8%(148)	-3.7%
Car accidents	4.8% (22)	3.5% (17)	-0.5%
Being stuck outside in bad weather	2.2% (10)	0.6% (3)	-1.6%
Fainting	0.4% (2)	1.2% (6)	+0.8%
Incorrect answers:	41.5%	36.1%	-5.4%
I don't know	6.3% (29)	5.0% (24)	-1.3%
Total	458	481	
Skipped			

***Reviewed Answers After Pretest***

***Did Not Review Answers***

Responses	Pretest	Posttest	%Change	Pretest	Posttest	%Change
FOBG	49.5% (103)	56.9% (123)	+7.4%	52.3% (91)	57.9% (110)	+5.6%
BC	36.1% (75)	31.0% (67)	-5.1%	31.6% (55)	31.6% (60)	0%
CA	5.8% (12)	4.2% (9)	-1.6%	4.6% (8)	3.7% (7)	-0.9%
BSOBW	1.9% (4)	0.5% (1)	-1.4%	2.3% (4)	0.5% (1)	-1.8%
F	0.5% (1)	1.9% (4)	+1.4%	0.6% (1)	1.1% (2)	+0.5%
IDK	6.3% (13)	5.6% (12)	-0.7%	8.6% (15)	5.3% (10)	-3.3%
Incorrect answers	44.3%	37.6%	-6.7%	39.1%	36.8%	-2.3%
Total	208	216		174	190	

During the pretest, about half of students correctly answered that the cause of most injuries during an earthquake is flying objects and broken glass, and the percentage of correct answers increased after ShakeOut in both the group that reviewed the correct answers and the group that did not. However 36.1% of the respondents chose other answers in the posttest indicating they believe there are more common causes of injury than flying objects and broken glass. The most common answer after “flying objects and broken glass” was “building collapse.” Review of the correct answers appears to have reduced the number of students choosing “building collapse” during the posttest, but more than a third of students in both groups still chose incorrect answers.

***If an earthquake happened while you are outside, there are couple different things you could do to protect yourself from injuries. Check Yes, No or Not Sure for each possible action.***

***Go inside to get under a table or desk***

Responses	Pretest	Posttest	%Change
No	67.4% (322)	67.6% (328)	+0.2%
Yes	18.0% (86)	21.6% (105)	+3.6%
Not sure	14.6% (70)	10.7% (52)	-3.9%
Total	478	485	
Skipped	17	22	

The majority of students picked the correct answer 'No' during the pretest and posttest, however, approximately a third of students responded incorrectly or chose 'I don't know' in the posttest.

***Hold on to a tree and try to stay standing***

Responses	Pretest	Posttest	%Change
No	67.9% (322)	74.6% (359)	+6.7%
Yes	13.1% (62)	12.1% (58)	-1.0%
Not sure	19.0% (90)	13.3% (64)	-5.7%
Total	474	481	
Skipped	21	26	

***Reviewed Answers After Pretest***

***Did Not Review Answers***

Responses	Pretest	Posttest	%Change	Pretest	Posttest	%Change
No	63.6% (138)	72.2% (151)	+8.6%	70.8% (126)	72.5% (140)	+1.7%
Yes	12.4% (27)	12.4% (26)	0%	13.5% (24)	13.0% (25)	-0.5%
Not sure	24.0% (52)	15.3% (32)	-8.7%	15.7% (28)	14.5% (28)	-1.2%
Total	217	209		178	193	

During the pretest, 67.9 percent of students correctly answered 'No' and the percentage of correct answers increased after ShakeOut by 6.7%. However, most of the increase in correct answers, as well as the decrease in the response 'Not sure' in the posttests can be attributed to the group of students who reviewed the correct answers after the pretest.

**Cover my head and neck with my arms**

Responses	Pretest	Posttest	%Change
Yes	74.4% (354)	84.9% (415)	+10.5%
No	13.2% (63)	7.0% (34)	-6.2%
Not sure	12.4% (59)	8.2% (40)	-4.2%
Total	476	489	
Skipped	19	18	

**Reviewed Answers After Pretest**

**Did Not Review Answers**

Responses	Pretest	Posttest	%Change	Pretest	Posttest	%Change
Yes	75.1% (163)	82.8% (178)	+7.7%	70.6%(127)	85.1% (166)	+14.5%
No	14.3% (31)	8.8% (19)	-5.5%	14.4% (26)	7.2% (14)	-7.2%
Not sure	10.6% (23)	8.4% (18)	-2.2%	15.0% (27)	7.7% (15)	-7.3%
Total	217	215		180	195	

The majority of students correctly identified “Cover my head and neck with my arms” as a protective action, and the proportion of correct answers increased after ShakeOut by more than ten percent. The increase in correct knowledge after ShakeOut was more significant among students who did not review the correct answers after the pretest.

**Move away from overhead hazards**

Responses	Pretest	Posttest	%Change
Yes	95.0% (460)	95.6% (473)	0%
No	1.9% (9)	2.0% (10)	+0.1%
Not sure	3.1% (15)	2.4% (12)	-0.7%
Total	484	495	
Skipped	11	2	

**Move away from electrical lines**

Responses	Pretest	Posttest	%Change
Yes	95.4% (461)	97.2% (483)	+1.8%
No	1.7% (8)	1.6% (8)	-0.1%
Not sure	2.9% (14)	1.2% (6)	-1.7%
Total	483	497	
Skipped	12	10	

The vast majority of student correctly identified that they should “Move away from electrical lines” and “Move away from overhead hazards”, both before and after ShakeOut.

**What is the most important part of your body to protect from injury during an earthquake? (pick one)**

Responses	Pretest	Posttest	%Change
Head	97.1% (472)	96.8% (483)	0%
Arms	0.8% (4)	0.8% (4)	0%
Legs	0.2% (1)	1.2% (6)	+1.0%
Feet	0.4% (2)	1.2% (6)	+0.8%
I don't know	1.4% (7)	0.0% (0)	-1.4%
Total	486	496	
Skipped	9	11	

In both the pretest and posttest, the vast majority of children correctly chose the head as the most important part of the body to protect during an earthquake.

**Would you “Drop, Cover and Hold On” if you are at home during an earthquake? (pick one)**

Responses	Pretest	Posttest	%Change
Definitely would	46.0% (225)	44.3% (220)	-1.7%
Probably would	33.9% (166)	36.8% (183)	+2.9%
Would total	79.9%	81.1%	+1.2%
Probably not	8.8% (43)	10.5% (52)	+1.7%
Definitely not	3.1% (15)	3.4% (17)	+0.3%
Would not total	11.9%	13.9%	+2.0%
Not sure	8.2% (40)	5.0% (25)	-3.2%
Total	489	497	
Skipped	6	10	

Both before and after ShakeOut, the majority of students (81.1 percent) indicated that they would “Drop, Cover and Hold On” if they were at home. Approximately a fifth indicated they would not “Drop, Cover and Hold On” or are not sure. Unfortunately we cannot determine from this study why these students indicated they would not likely “Drop, Cover and Hold On” at home. The percentage of responses did not change significantly from the pretest to the posttest.

**Have you learned about what to do to prepare for tsunamis that can happen in Washington state? (pick one)**

Responses	Pretest	Posttest	%Change
Yes	85.5% (414)	85.5% (423)	0%
No	7.9% (38)	5.9% (29)	-2.0%
Not sure	6.6% (32)	8.7% (43)	+2.1%
Total	484	495	
Skipped	11	12	

A high proportion of students indicated that they had learned about tsunami preparedness before ShakeOut and this percentage did not change after ShakeOut.

**Please indicate where you learned about what to do to prepare for tsunamis. (select all that apply)**

Responses	Pretest	Posttest	% change
At school	95.8% (410)	94.5% (414)	-1.3%
At home	46.9% (201)	41.8% (183)	-5.1%
Boy Scouts / Girl Scouts	6.8% (29)	7.3% (32)	+0.5%
Other (please specify)*	7.4% (32)	6.6% (29)	-0.8%
Summer camp	3.7% (16)	4.1% (18)	+0.4%
Total	428	438	
Skipped	29	40	

*\*Other Pretest*

- Common Sense (7)
- TV / internet / books (6)
- Unspecified (5)
- Museums / Tribal Center (4)
- Church (3)
- Fire Dept. (3)
- Friend's house (2)
- Day care (1)
- Experienced earthquake (1)

*Other Posttest*

- TV / internet / books (9)
- Unspecified (8)
- Museums / Tribal Center (4)
- Common Sense (4)
- Church (2)
- Fire Dept. (1)
- Experienced earthquake (1)

The vast majority of students who had previously learned about tsunami preparedness indicated that they had learned this in school. However this percentage went down from the pretest to the posttest. The student responses to this question may have been impacted by memory bias.



***If you are near the ocean and an earthquake occurs, what should you do once the shaking stops? (pick one)***

<b>Responses</b>	<b>Pretest</b>	<b>Posttest</b>	<b>% change</b>
Go to higher ground or the top floor of a high building immediately	90.6% (424)	90.5% (440)	-0.1%
Go to the beach to see if a tsunami is coming	2.6% (12)	2.7% (13)	+0.1%
Stay where you are and wait for tsunami warning signals	2.4% (11)	3.5% (17)	+1.1%
Call 911 to find out if there is a tsunami warning	1.7% (8)	1.6% (8)	-0.1%
I don't know	2.8% (13)	1.6% (8)	-1.2%
Total	468	486	
Skipped	27	19	

The vast majority of the students correctly chose 'Go to higher ground or the top floor of a high building immediately' both in the pretest and posttest, and the proportion of correct answers did not change after ShakeOut. Around ten percent of students chose an incorrect answer.

***Do you feel upset when you think or talk about earthquakes and tsunamis? (pick one)***

<b>Responses</b>	<b>Pretest</b>	<b>Posttest</b>	<b>% change</b>
Not at all	58.0% (279)	58.2% (286)	+0.2%
Only once in a while	15.0% (72)	15.7% (77)	+0.7%
Sometimes	15.2% (73)	14.9% (73)	-0.3%
Most times	5.2% (25)	4.7% (23)	-0.5%
Every time	6.7% (32)	6.5% (32)	-0.2%
Total	481	491	
Skipped	14	14	

Most students, 73.9 percent in the posttest, do not or rarely feel upset when they think or talk about earthquakes and tsunamis. There was no significant change in responses after ShakeOut.

***Questions on the posttest only***

Of the 574 participants, 74 percent completed a pre- and posttest (n=428) and 14 percent completed a posttest only (n=79), for a total of 507 respondents for the following questions. Twelve percent of students (n=67) completed a pretest only and did not answer these questions.

**During the ShakeOut earthquake drill in your school, did you “Drop, Cover and Hold on”? (pick one)**

Responses	Posttest
Yes	89.3% (450)
No	6.7% (34)
Not sure	2.2% (11)
I was not there	1.8% (9)
Total	504
Skipped	3

Most students indicated that they practiced “Drop, Cover and Hold On” during the ShakeOut drill. In the posttest, about nine percent of students indicated ‘No’ or ‘Not sure.’

**During the ShakeOut earthquake drill in your school, did you practice evacuation for a tsunami? (pick one)**

Responses	Posttest	North Beach only	Ocosta only
Yes	71.3% (360)		
No	22.0% (111)	23.1% (61)	20.7% (50)
Not sure	5.0% (25)	5.7% (15)	4.1% (10)
I was not there	1.8% (9)		
Total	505		
Skipped	2		

About a quarter of students in both school districts were not aware they were practicing a tsunami drill or do not perceive the second floor evacuation as the correct tsunami evacuation procedure. The proportion of students responding ‘No’ and ‘Not sure’ was slightly higher in North Beach School District compared to Ocosta School District.

**What I knew before and after ShakeOut about what to do during an earthquake (two 4-point Likert scale questions):**

Responses: My earthquake knowledge after ShakeOut:	Responses: My earthquake knowledge before Shakeout				Response Totals
	Nothing (1)	Very little (2)	Some (3)	A lot (4)	
Nothing	40.0% (4)	0.0% (0)	1.5% (3)	6.7% (17)	
Very little	20.0% (2)	11.1% (3)	4.0% (8)	5.6% (14)	
Some	30.0% (3)	40.7% (11)	49.5% (100)	4.4% (11)	
A lot	10.0% (1)	48.1% (13)	45.0% (91)	83.3% (210)	
Rating Average	2.10 (10)	3.37 (27)	3.38 (202)	3.64 (252)	3.49 (491)

No change: 64.6% (317)  
 Positive change: 24.6% (121)  
 Negative change: 10.8% (53)  
 Skipped one or both questions: 16

**What I knew before and after ShakeOut about what to do during a tsunami (two 4-point Likert scale questions):**

Responses: My tsunami knowledge after ShakeOut:	Responses: My tsunami knowledge before ShakeOut:				Response Totals
	Nothing (1)	Very Little (2)	Some (3)	A lot (4)	
Nothing	26.1% (6)	2.3% (1)	1.7% (3)	6.3% (16)	
Very little	21.7% (5)	15.9% (7)	4.7% (8)	5.5% (14)	
Some	30.4% (7)	54.5% (24)	50.6% (87)	5.5% (14)	
A lot	21.7% (5)	27.3% (12)	43.0% (74)	82.7% (210)	
Rating Average	2.48 (23)	3.07 (44)	3.35 (172)	3.65 (254)	3.44 (493)

No change: 62.9% (310)

Positive change: 25.8% (127)

Negative change: 11.3% (56)

Skipped one or both questions: 14

About a quarter of students in both schools districts felt they had gained knowledge about earthquake response and tsunami response after ShakeOut. The majority of students felt they had no change in knowledge. A small proportion of students indicated they had less knowledge after ShakeOut. Some of the students who perceived that they knew less after ShakeOut may have perceived the question as “How much did you learn after ShakeOut?” and responded that they had learned “Nothing” or “Very little,” which resulted in a negative change in knowledge from the pretest to the posttest. Another possible explanation for the negative change in knowledge is that some students may have perceived that they knew some or a lot about earthquake or tsunami response before the ShakeOut drills, but the ShakeOut drills and other classroom activities may have caused them to draw the conclusion that they knew less than they thought.

## 7.0 TEACHER SURVEY RESULTS

Thirty-five (35) teachers and school staff responded to the paper or online post-ShakeOut questionnaire. A paper survey was first distributed to teachers in a packet with the student questionnaires and instructions, but few completed teacher questionnaires were returned. Subsequently, an online survey was created and was emailed to the teachers by the school principals, which resulted in a 100 percent response rate. The results include responses from all 29 teachers who administered pretests and posttests to their classrooms, and six teachers and school staff from Ocosta School District who did not participate because they had no classes during third period or taught special education classes that did not participate in the ShakeOut evaluation. Of the 29 teachers who administered student surveys, 17 are from Ocosta School District and 12 are from North Beach School District.

***Did your classroom practice “Drop, Cover and Hold On” during the ShakeOut drill on Thursday, October 18?***

Responses	
Yes	94.3% (33)
No	0.0% (0)
Other	5.7% (2)
Total	35

***Did your classroom participate in the school-wide tsunami procedures on Thursday, October 18?***

Responses	
Yes	94.3% (33)
No	0.0% (0)
Other	5.7% (2)
Total	35

The two “Other” responses for each question indicated that they did not have a class during the ShakeOut drills on October 18, 2012, which took place at 10:18am.

***Did you voluntarily do any other classroom or homework activities on earthquake and tsunami preparedness before ShakeOut on October 18 (between Sep. 1 – Oct. 18, 2012)?***

Responses	
Yes	48.6% (17)
No	51.4% (18)
Total	35

***If yes, which activities did you do? (select all that apply)***

<b>Responses</b>	
Classroom lesson on earthquake science (e.g. plate tectonics)	11.8% (2)
Classroom lesson on earthquake protective actions (e.g. Drop, Cover and Hold On)	41.2% (7)
Homework activity on earthquake preparedness (e.g. home kits)	17.6% (3)
Classroom lesson on tsunami science (e.g. causes)	23.5% (4)
Classroom lesson on tsunami protective actions (e.g. go to high ground)	47.1% (8)
Homework activity on tsunami preparedness (e.g. family plan)	17.6% (3)
Other (please specify)	47.1% (8)
<b>Total</b>	<b>17</b>

***If yes, how much classroom time did you spend on these activities? (pick one)***

<b>Responses</b>	
Less than 1 hour	76.5% (13)
1-2 hours	17.6% (3)
2-5 hours	5.9% (1)
More than 5 hours	0.0% (0)
Other	0.0% (0)
<b>Total</b>	<b>17</b>

Approximately half of teachers indicated they did some type of classroom activity about earthquakes or tsunami science or preparedness. The eight “Other” responses include “Discussion” (n=3); “[ShakeOut] surveys”(n=1); “In class discussion on causes and effects” (n=1); “Powerpoint on ‘Go Kits’” (n=1); “Talked about procedures for during an earthquake/tsunami” (n=1); and “Explained design of school in regards to earthquake/tsunami, researched drop, cover, and hold and why we do that” (n=1). Three of the 29 participating teachers provided a homework activity to students. The one teacher who indicated 2-5 hours of classroom activities is a teacher whose students did not participate in completing the student questionnaires due to parent non-consent.

Among those teachers who did additional educational activities beyond ShakeOut, only four teachers spent more than one hour on these activities.

**Do you feel upset or when you think or talk about earthquakes and tsunamis? (pick one)**

Responses	
Every time	8.8% (3)
Most times	2.9% (1)
Sometimes	14.7% (5)
Only once in a while	14.7% (5)
Not at all	58.8% (20)
Total	34

The majority of teachers, 73.5 percent, do not or rarely feel upset when they think or talk about earthquakes or tsunami. Four teachers indicated they become upset most times or every time, and it is useful to understand how this impacted their classroom activities on disasters before and during ShakeOut. Two of the four teachers indicated that they did additional activities on earthquake and tsunami preparedness with their classrooms. One teacher spent less than one hour on the activities, while the other teacher spent two to five hours on the activities. Two of the four teachers indicated that drills should be done twice a year and two indicated they should be done more than twice a year. The classrooms of all four teachers practiced “Drop, Cover and Hold On” and the tsunami procedures during ShakeOut. In sum, these particular teachers who indicated that they become upset when they think or talk about earthquake and tsunamis did not avoid disaster drills or classroom activities on the topic of disasters.

**Did you review the correct answers to student Shakeout survey with your students (included in your packet)?**

Responses	
No	34.3% (12)
Yes once, after I administered the pre-ShakeOut questionnaires	28.6% (10)
Yes once, after I administered the post-ShakeOut questionnaires	5.7% (2)
Yes twice, after I administered the pre-ShakeOut and after the post- ShakeOut questionnaires	2.9% (1)
Other (please specify)	28.6% (10)
Total	35

Twelve teachers did not review the correct answers to the student questionnaires at all, and two teachers reviewed the correct answers after the posttest. Ten teachers reviewed the correct answers to the student questionnaires after the pretest, and one teacher reviewed the correct answers twice, after both the pretest and posttest. Ten teachers responded “Other” and their written explanations include “Not sure” (n=1); “Did not have students” (n=4); and five respondents did not provide any written explanation.

For a comparison of questionnaire results of students who had reviewed the correct answers and those that did not review the correct answers before taking the posttest, the results from the students of the 11 teachers who answered “Yes once, after I administered the pre-ShakeOut survey” and “Yes twice, after I administered the pre-ShakeOut and after the post-ShakeOut survey” were combined to create the “Reviewed” group (263 students). The results of the students of the 14 teachers who had answered “No” or “Yes once, after I administered the post-ShakeOut survey” were combined to create the “Did Not Review” group (225 students). The responses of the students whose teachers responded “Other” (86 students) were not included in the comparison groups.

***Have you used the new WA state teaching resource (May 2012) “Earthquake and Tsunami Information and Resources for Schools: Surviving Great Waves of Destruction”?***

Responses	
Yes	2.9% (1)
No	40.0% (14)
Not aware of this resource	57.1% (20)
Total	35

Most teachers were not aware of this resource, and if aware, they did not use it for their classroom activities before or during the ShakeOut drills.

***How often do you think your school should conduct school-wide earthquake and tsunami drills?***

Responses	
More than twice a year	20.0% (7)
Twice a year	62.9% (22)
Once a year	17.1% (6)
Once every two years	0.0% (0)
Once every three years	0.0% (0)
Never	0.0% (0)
Total	35

Most teachers prefer drills to be twice a year or more (82.9 percent). No teachers felt that the drills should be done less than once a year.

***Anything else you would like me to know about your experience administering the ShakeOut surveys or the drill itself? (open-ended question)***

- “We need a detailed plan that is simple yet effective.”
- “We need a better evacuation plan than vertical evacuation, like a unit that will rise with the water and hold emergency supplies in it.”
- “We need to practice the drill more than once a year.... I teach junior high students and they need constant and continual practice in order to understand and remember procedures.”
- “Some students are not taking it seriously, and having the small students from the elementary school come over makes it a big joke.”
- “We last did a drill about 6 months ago. I always follow it up in my science classes with a discussion of tsunami and earthquake preparedness.”
- “I feel that we should conduct a drill more often. I don't think that the students realize the precarious situation we are in living this close to the ocean. Some students feel it would be safer to leave the school instead of going to the upper level. Recently we had another conversation about an earthquake/tsunami and I was surprised that many students still did not have a family plan.”



## **8.0 FINDINGS AND DISCUSSION**

The findings of this evaluation are both expected and surprising. Among children in grades six to 12 in North Beach and Ocosta School Districts, there were high levels of familiarity and correct knowledge about protective actions for earthquakes and tsunami both before and after ShakeOut, indicating that these students have a strong base of knowledge from the “Drop, Cover and Hold On” drills they have practiced biannually in their classrooms. There were a number of other strengths identified as summarized below. However, the findings also indicate that significant portions of students have varying levels of knowledge and comprehension of the risks that cause injury and in some case have difficulty applying what they have practiced in the classroom to situations outside the classroom. Thus, findings also indicate areas for improvement. Below is a summary of the strengths of current school-based disaster drills and education, areas for improvement and other major findings. Then, some additional considerations around overall lessons learned and study limitations follows.

### **8.1 STRENGTHS OF CURRENT SCHOOL-BASED DISASTER DRILLS AND EDUCATION**

The ShakeOut evaluation elucidated that both before and after ShakeOut, students in both school districts had strong knowledge of the definition of “Drop, Cover and Hold On” and its purpose as a protective action for falling objects and broken glass during earthquakes. The participating children also had strong knowledge that they should go to high ground immediately after an earthquake for protection from a tsunami. The vast majority of children also knew to take cover under a table and cover their neck and head during an earthquake, and if outside, to cover their head and neck and move away from overhead hazards. They also demonstrated sound judgment for several “common sense” questions; for example, the vast majority of students correctly identified the head as the most important part of the body to protect, and correctly identified that they should move away from electrical wires and overhead hazards if they are outside during an earthquake. These levels of correct knowledge among students before ShakeOut indicate that previous education efforts, whether through school-based disaster drills or classroom lessons, have been effective in teaching children some of the most important principles of how to protect themselves during an earthquake or tsunami emergency. Although most children indicated that they had the same levels of knowledge after ShakeOut, about a quarter of students in both school districts indicated that they knew more about what to do during an earthquake or tsunami after ShakeOut.

Both children and teachers indicated low levels of upset when thinking or talking about earthquakes or tsunami, both before and after ShakeOut. The ShakeOut drills did not appear to increase levels of upset among the children and teachers who participated in the survey, and the few teachers who indicated that they often or always become upset participated in the ShakeOut drills and half of them also facilitated classroom activities on disaster science and protective actions. This is a positive sign that the ShakeOut drills were executed in a way that did not increase fears or anxiety about disasters.

There appears to be a high level of teacher buy-in for the disaster drills with most teachers indicating that drills should be done at least twice a year, and several teachers provided comments on the need for more comprehensive plans and drills. Approximately half of the participating teachers also voluntarily conducted classroom activities on disaster science and preparedness actions. School leadership may have more teacher support than expected to implement additional educational classroom activities for children beyond school-wide disaster drills.

The vast majority of children indicated that they learned about earthquake and tsunami preparedness before ShakeOut. Most learned about preparedness at school, while less than half indicated they learned outside of school, highlighting the important role of school-based disaster preparedness education.

## **8.2 AREAS OF IMPROVEMENT**

The Shakeout drills increased the proportion of correct answers and decreased the proportion of incorrect answers in a few important areas, but for many questions there was no significant improvement in knowledge or risk perceptions. For example, during the posttest approximately the same proportion of students, two-thirds, incorrectly responded that it would be protective to go to a doorway during an earthquake. Also, despite the ShakeOut drills, most of the students were not aware of the risk of falling during an earthquake, or do not perceive falling as a risk.

Although most students were able to apply their knowledge to identify correct protective actions when outside the classroom setting, approximately a third of students did not know or were not sure what to do if they are outside during an earthquake, or inside but not near a table or desk to cover under. Also while flying objects and broken glass pose the greatest danger, more than a third of children believe there are more common causes of injury, such as building collapse.

It is not surprising that many students were not familiar with the phrase “Triangle of Life”; however, when asked about getting next to desk, as opposed to under one, about half of students were not able to use what they have learned about “Drop, Cover and Hold on” to conclude that getting next to a desk would not be protective during an earthquake. Also, after ShakeOut, about 19 percent of students indicated they would not or were not sure if they would “Drop, Cover and Hold On” while at home during an earthquake, indicating that this is an area in need of education. Inaccurate risk perceptions could lead children to come to the wrong conclusions about what to do during an earthquake, such as run outside.

An important finding was that more than a quarter of students in both school districts did not know or were not sure if they participated in a tsunami evacuation drill during ShakeOut, indicating students need to be provided more comprehensive information about the intention and purpose of the vertical evacuation drills.

### 8.3 OTHER FINDINGS

For the most part, reviewing the correct answers to the student questionnaire before taking the posttest resulted in higher proportions of correct answers and lower proportions of incorrect answers on the posttests. For example, compared to children who had not reviewed the answers, a higher percentage of children who had reviewed the correct answers before the posttest identified “Drop to your knees and cover your head and neck” as a correct action when inside a room with or without a desk to cover under, and identified “Go outside to an open area” and “Hold on to a desk or tree to stay standing” as incorrect actions. While some of the responses benefitted from the review process, there are a few key exceptions. Review of the correct answers did not result in improved knowledge of the “Triangle of Life” (i.e. getting next to a desk) or “Go inside to get under a table or desk” as incorrect actions, and it did not result in improved knowledge about the risk of falling during earthquake shaking, or that going to a doorway is an incorrect action.

Less than half of the participating teachers did additional activities relating to disaster science and disaster preparedness beyond the ShakeOut drills. For those that did, most of them spent less than one hour on these activities. The evaluation found that most teachers were not aware of, or were aware of and did not use, the new Washington state teaching resource *Earthquake and Tsunami Information and Resources for Schools: Surviving Great Waves of Destruction* (Crawford & Thurman, 2012).

## 9.0 LESSONS

The ShakeOut drills helped maintain high levels of correct knowledge of key protective actions for earthquakes and tsunamis. On the other hand, the findings also indicate that there is likely to be value in providing students with some context for the drills in advance, to help them understand how and why the earthquake and tsunami drills are done and the purpose of the procedures that have been chosen. For example, it is important for students to understand why school leadership have chosen vertical evacuation inside the school during a tsunami as opposed to evacuation by foot or vehicle to higher ground. Without this comprehension, children may become confused and frightened during an emergency and may not follow the instructions of teachers and school leadership. This is a particular risk for high school students who have the ability to leave the school grounds on their own after an earthquake.

The vast majority of the participating children indicated that they had learned about what to do during an earthquake or tsunami before ShakeOut, but less than half of these students learned somewhere other than school. This indicates that to improve community preparedness, response and resilience, school-based learning is imperative. Without school-based learning, some children may never receive a lesson on protective actions and preparedness measures. School-based learning can be linked to learning at home through simple interactive homework exercises and other parent engagement activities.

These results indicate that disaster drills that routinely take place in the classroom are not particularly effective at helping children learn knowledge and skills that can be applied in emergencies that happen when children are outside their classrooms. Also, while the ShakeOut drills helped children retain and practice important protective measures, for most students these drills did not instigate gains in new knowledge. Beyond rote practice of responses, drills and classroom lessons should teach children: (1) do not run outside during an earthquake and move as little as possible during ground shaking, as flying objects and broken glass pose the greatest danger; (2) stay inside if inside, and if there is no desk or table to shelter under, “Drop, Cover and Hold On” near an interior wall and away from windows; (3) stay outside if outside, and “Drop, Cover and Hold On” where you are unless you need to move away from overhead hazards like power lines; and (4) “Drop, Cover and Hold On” applies almost anywhere you are during an earthquake, including at home.

School-wide disaster drills could be improved by holding them at unexpected times and locations, for example, while children are outside or while they are in rooms or hallways that do not have tables and desks. When asked what they would do if they were not near a desk or table during an earthquake, almost a third of students chose incorrect answers, including “Go to another room to find a desk or table to cover under.” For those who have never experienced an earthquake, it can be difficult to imagine how an earthquake would make it difficult to walk or run, and so, unsurprisingly, some children answering this question defaulted to the advice to get under a table or desk. Therefore, varying disaster drills that help children practice “Drop, Cover and Hold On” near internal walls and far from windows may be valuable.

The comparison of results of students who reviewed the answers to the questionnaire to those who did not revealed that even a small amount of classroom review of disaster risks, preparedness measures and both correct and incorrect actions during an emergency can make a difference in improving children's knowledge of risks and protective actions. An additional layer of classroom, homework or afterschool educational activities should aim to help children develop more accurate risk perceptions and adaptive, problem-solving capabilities.

Most of the children who participated in this evaluation rarely or never become upset when thinking or talking about disasters. Overall, the ShakeOut drills and classroom activities facilitated by some teachers appear to have had no effect, positive or negative, on the proportions of children that indicated high levels or low levels of upset. This provides some evidence to the growing body of research that well-executed disaster drills and disaster preparedness education do not increase negative emotional arousal in children (Ronan & Johnston, 2010, 2001).

## 10.0 STUDY LIMITATIONS

This evaluation has several limitations. First, because this study used a purposive sample of two school districts in Washington state, the results of this evaluation cannot be generalized to students and teachers at other school districts in Washington state or other areas of the United States. Second, while the student questionnaires were piloted with a small group of students in Washington state in advance of the study, some children may have misunderstood the intent of some of the questions, and where this may have occurred is noted in the results. Third, for some questions that required children to remember events that happened more than a month before the evaluation, such as the “*Have you learned about what to do to prepare for earthquakes that can happen in Washington state?*”, children may not have given an accurate answer due to difficulty remembering past events (Bell, 2007). To mitigate non-response and inaccurate answers due to memory bias, the response “Not sure” was added to all questions where memory of events could be challenging. The results of this study are also limited to an evaluation of short-term learning outcomes since the posttest was administered within a week of the ShakeOut drills.

## **11.0 CONCLUSIONS**

Findings of this evaluation support the hypothesis that drills like ShakeOut can help children gain and retain knowledge of protective actions like “Drop, Cover and Hold On” and moving to high ground in the event of a tsunami. The vast majority of participating students had correct knowledge of protective actions for earthquakes and tsunami before the ShakeOut drill, indicating that previous education and disaster drills in these two school districts have been effective in raising and maintaining children’s awareness of what to do during these disasters. On the other hand, the findings indicate that school-based disaster drills should be complemented with additional classroom learning and discussion to help children understand how to apply their knowledge to unfamiliar situations where they must independently assess risk and make decisions. Therefore, both schools districts would benefit from classroom integration of disaster education curriculum to provide context to the disaster drills and help children build more adaptive, problem-solving capabilities based on an accurate knowledge of risks.

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