

Earthquake education curricula: a necessary step in mitigating loss of life in the schools

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ABSTRACT

Knowing what to expect, how to prepare and respond to an earthquake is a proven method of mitigating loss of life and property. Teaching this knowledge is the responsibility of today's educators.

Effective earthquake education teaches students both earthquake science and safety, clarifies misperceptions, empowers the school community to realize they can survive a major earthquake, contributes to building a generation of earthquake-cognizant adults, and reduces future loss of life.

In order to begin an earthquake education program, educators need to have information about available earthquake education materials.

In May, 1988, an education project was initiated at the National Center for Earthquake Engineering Research. A primary task of this project was determining who offered earthquake education and identifying the materials being used by students in grades K-12.

This presentation will provide a general overview of earthquake education curricula highlighting similarities and differences and noting areas in need of development.

INTRODUCTION

Earthquake education has an important role in both school and society. All 50 states are vulnerable to earthquakes and at least 39 of these are subject to moderate or major seismic risk, as are the most heavily populated parts of Canada. Millions of people are exposed to significant earthquake hazards. When the mobility of society is taken into consideration, the number of individuals who may one day experience a damaging earthquake is even greater. In this century, earthquakes in North America have resulted in more than a thousand deaths and billions of dollars in property damage. Earthquake education that provides an understanding of the causes of earthquakes, their

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impact, and the necessary steps to reduce loss of life and property is essential to our physical and emotional well-being.

Children spend a significant portion of their day in schools. The school community needs to be well-prepared to meet school earthquake emergencies in order to protect the welfare of students and staff both during and after the ground shaking. The development of an effective disaster preparedness program requires an understanding of the natural processes involved and the type of dangers they pose to the school community. Psychological issues of anticipatory anxiety, emotional trauma, response and recovery must also be considered. Appropriate countermeasures to reduce earthquake damage and personal harm can then be included in school and home emergency response plans.

Children and their teachers do not automatically understand earthquake-generating mechanisms or know appropriate responses during an earthquake. A preliminary study by Ross and Shuell (1989), in which 35 students in kindergarten through sixth grade were interviewed, found that elementary school children had misconceptions about earthquakes, what occurs during an earthquake, what causes an earthquake, and what one should do during an earthquake. Subsequent interviews of students in fourth to sixth grades have continued to support this observation (Ross & Shuell, 1990a, b).

The cause of an earthquake and knowing what to do in response to such an event were especially difficult for the students in these studies. No student in the K-6 group (Ross & Shuell, 1989) mentioned plate movement as a cause of earthquakes. Causes indicated by students included the earth's core getting too hot, faults, lots of wind, loud noises, thunderstorms, drilling in the sidewalks, heat from the sun on the earth, and lava. Students showed confusion between earthquakes and volcanoes, and earthquakes and tornadoes.

After the October, 1989 Loma Prieta earthquake, some fourth graders in a school outside of California wrote the following: "If there were an earthquake I would go on a plane and I would go to Mexico and I would stay there until the earthquake was over and then I would go back." "If an earthquake came I would hurry up and go to the store and get some food and go back home and go in the basement and stay there." "If there was an earthquake I would go to the airport and get on the airplane and go to New York City and stay. I would go buy me a gun."

In the K-6 group (Ross & Shuell, 1989) only 9% of the students gave a clearly correct answer for what to do in an earthquake. Some fourth graders in New York (Ross & Shuell, 1990a, b) specifically mentioned metal when stating that one would be safe in an inside doorway. Probing of this response indicated that some children felt metal would protect them rather than the structure of the building. As one fourth grader stated, "An earthquake doesn't do metal. It does concrete."

Subsequently, a question was added to the "appropriate action" section of an Earthquake Information Test (Ross & Shuell, 1990a), that stated persons should hold on to something metallic. Thirty-three percent of 194 fourth, fifth, and sixth graders from New York and Utah marked this question "true."

Research shows that students have both difficulties in understanding the science of tectonic processes and applying scientific principles to mitigation strategies. Taking action appropriate to the particular environment seems to require understanding of the concept behind that action.

In order to meet the needs of our children in this important area, it is imperative that educators are provided with curricular information and background support materials so that valuable time and resources are not spent redesigning what is already available. Time can then be devoted to regionalizing existing materials, deciding what concepts are most crucial to teach at each age, developing teaching strategies that maximize conceptual understanding, designing materials for those groups of students that are currently not being reached, and intervening with at-risk students to encourage interest in science.

THE ROLE OF ENGINEERS

The role of engineers in earthquake hazards mitigation is to evaluate and understand the seismic performance of buildings and other structures, and to develop methods to enhance that performance. In terms of earthquake education, the engineering community is encouraged to play a dual role. First, as a visible, accessible presence to the school community advising them on structural weaknesses, and the expansion of the earth science and earthquake education curricula to include seismic design concepts; and second, as educators to our future engineers. As earthquake awareness and education grow, more and more students will take an interest in earthquake mitigation measures, including structural design. There is a need for engineers to develop some simple activities that can be done in classrooms to encourage those students.

EARTHQUAKE EDUCATION CURRICULA

Some curricula provide only scientific or safety information. Because a well-balanced earthquake education curriculum is an integration of the two, it is important that the missing half is simultaneously provided. Failure to do so may inadvertently perpetuate misperceptions, cause students to view science as something separate from daily life, and as a result, fail to encourage them to select science and engineering careers.

The following is a brief overview of some existing curricula:

For grades 4-8

CALEEP Curriculum

Lawrence Hall of Science

"Mini-Kit" consists of 14 hands-on earthquake education activities:

- a. Teacher's Guide - including blackline masters
- b. Computer Disk - (Apple II+ and/or IIe with disk drive)
Quake: A Computer Simulation and
Survival: A Computer Simulation Game
- c. Filmstrip
- d. Audio Cassette Tape - disc jockey, Mr. Pate,
experiencing 1964 Alaska Earthquake

e. AAA map California

Quake BINGO, Await the Quake game, and Simulator Kit may be purchased separately. The Complete CALEEP Kit contains 22 activities.

I Can Make X the Difference
Utah State PTA

For Primary Grades,
written at 4th grade
reading level.

This contains a series of units on a number of areas involving emergency preparedness: fire, earthquake, flood, nuclear war, and weather problems. Each unit is organized according to the same format and includes: a picture of a house in the student's community which becomes a home when each child imagines he lives there; an introductory poem; "What Would I Do" exercises; "Things I Should Know;" and games and puzzles. The earthquake section includes a map showing Utah earthquakes, an earthquake work hunt, and safety rules crossword puzzle.

Crustal Evolution Education Project

Designed primarily for
grades 7-12

This consists of 33 individual activity modules designed to provide students with an understanding "of the concepts behind plate tectonics and the physical Earth." Each module is individual, self-contained and designed for the Earth Science classroom. Modules include: "Locating Active Plate Boundaries by Earthquake Data," "Earthquakes and Plate Boundaries," "Plate Boundaries and Earthquake Prediction," "Hot Spots in the Earth's Crust," "Volcanoes: Where and Why?" and "Quake Estate," a board game to be played by two to four students, whose goal is, "to achieve success in net income based on accuracy of assessing earthquake risks" (copyright, 1979).

The CEEP is not intended to be a complete curriculum but designed to supplement any teacher's curriculum.

Earthquake Awareness and
Preparedness Curriculum
Junior League of Oakland-East Bay

For grades Pre-K-6;
has been used with
students up to 8th grade

This is a 1 hour curriculum that anyone can pick up and do. It is aimed at elementary students. There is a curriculum guide that provides lessons for each grade level, an Instructor's Guide from Environmental Volunteers, Inc., and role playing situations from CALEEP. There are also supporting videotapes that show each level of the curriculum that were prepared by JLOEB, the Albany Unified School District, and The Audubon Nature Training Society: preschool level, middle school, high school-adult (not included in the curriculum), and "School Facilitation." These can be borrowed from BAREPP.

Earthquakes: A Teacher's Package
for K-6/FEMA 159
Federal Emergency Management Agency

For grades: K-6

This 280 page curriculum was developed by the National Science Teachers Association and includes background material; sets of lessons and classroom

activities on earthquake science and safety topics for each of three grade levels (K-2, 3-4, 5-6); scope and sequence charts depicting multidisciplinary connections; masters for reproduction; references; and resources. This package is designed for teachers who have little or no science background.

** Currently, there are plans to also develop "earthquake" theme hands-on classroom activities for grades 7-12 in supplements to Physics, Earth Science, Geometry, Trigonometry, and Calculus.

Earthquakes (Module)
"Minorities in Engineering" Project

For grades: 8-10

This is a module designed to interest students in earthquakes through activities, modeling, engineering applications, and simulation strategies. Has 12 lessons: 1-5 introduce students to earthquakes; 6-9 talk about observed precursors of earthquakes and introduces seismograms; and 10-12 try to make earthquake investigation relevant to students. Includes directions for making related items and doing experiments, i.e. making your own tiltmeter, creepmeter, shoebox model of a fault simulator, liquefaction simulation, resonating building demonstration, and earthquake simulation. Includes reproducible charts and maps. Can be used in part or total in an earth science or general science course.

** NCEER has been given permission to reproduce copies of this module on request.

Guidebook for Developing a
School Earthquake Safety Program/
FEMA 88
Federal Emergency Management Agency

Designed to assist
school community
to develop and tailor
an earthquake safety
program for the school.

This is a 50-page guide plus appendices that include reprints of FEMA 46, 48, and 113.

The Guidebook includes:

- "The Planning Process"
- "Hazard Identification"
- "Earthquake Drills"
- "Immediate Response and Care Requirements"
- "Communication"
- "Post-Earthquake Shelter Planning"

Appendices include: "Teacher's Package on Earthquake Drills," and example of an earthquake safety program plan; sections on "Children and Disasters" and "Non-Structural Earthquake Damage."

This is designed mainly as a guidebook, not a curriculum. It allows the school to be its own planner. It is included in this listing because many districts noted that it was the curriculum they were using.

** FEMA 88a Earthquake Safety for Children. This 4-part booklet contains

excerpts from Units 5 and 6 of Earthquakes: A Teacher's Package for Grades K-6 (FEMA 151).

Hands-On Earthquake Learning Package
Environmental Volunteers

1. Instructor's Guide
 - a. 17 illustrated, plastic-protected Activity Folders
 - b. 16 information/activity inserts (including quake myths, games, puzzles, math activity, "tremor tales").
 - c. Illustrated text on basic earthquake geology: The Story of the Earth
 - d. Red Cross' Safety and Survival in an Earthquake
 - e. "Getting Ready for a Big Quake" - Sunset magazine
 - f. Complete guide to school earthquake planning
 - g. Neighborhood Preparedness Guide
 - h. "Plans for the Teaching Materials"

2. Hands-On Teaching Materials
 - a. Plate Tectonics Globe (removable plates)
 - b. Earth Hemisphere Model
 - c. Plate Puzzle map (ocean floor features)
 - d. Wood Plate/Fault Blocks
 - e. 9 ft. sq. plate tectonics rug (pattern also available)
 - f. Sea Floor Basalt rock sample
 - g. Sea Floor spreading box
 - h. Time cards, markers and time-tape
 - i. Continental Drift film (computer-generated)
 - j. Fault Zone Model
 - k. Magni-tube Model
 - l. Motor driven shaking table and accessories

I-Science Mate Program
(Integrating Math, Science and
Technology)
Math Science Nucleus

For grades: K-6

Plate Tectonic Cycle - The Earth on the Move (part of a master science curriculum consisting of six master themes and 24 subthemes).

1. Lab manuals for grades 2-6
2. Shaker tables (made of cardboard, marbles, wood, etc.)
3. Lessons/with experiments and worksheets for grades K-6. Plate Tectonics Cycle includes: Volcanoes, Earthquakes, Plate Tectonics, and Hazards. NCEER has copies of the lessons, experiments, and worksheets from K-6 and some books used in the lessons.
4. Also available from Math Science Nucleus:
 - a. Historical Earthquake Slides
 - b. Recent Earthquake Slides
 - c. Inflatable globe
 - d. Glue Balls - to illustrate faults have memory
 - e. Physiographic Relief Globe

Plan to Live
Utah State PTA

For Secondary grades;
written at 11th grade
reading level

This includes a series of lessons on various natural and manmade hazards, including earthquakes. Earthquake related lessons include: "What to Do in Case of an Earthquake," "How to Prepare for an Earthquake," and "Information You Should Know About Earthquakes." Test questions are included at the end of each lesson.

Teaching Earthquake Safety
in the Elementary Classroom
Utah Museum of Natural History

For grades: K-3

A 1/2 hour session gives children basic earthquake information utilizing simple activities, myths and factual information. It includes the Kamchatka Myth poster (originally obtained from CALEEP), Wasatch Fault poster and five follow-up activities (adapted from CALEEP to reflect the Utah scene). A Fault Blockset available from NASCO science is recommended. This curriculum is easily adaptable for general use outside of Utah. Note: Utah Museum of Natural History currently only source for CALEEP's Kamchatka Myth Posters.

Utah Geologic Hazards
Utah Museum of Natural History

For Grades 4 - Senior
High School

This includes a two-part slide presentation and a two foot square model of a section of the Wasatch Front. Part I - mountain leveling processes of rockfall, landslide, mudflow, flood, and lake level rises. Part II - mountain building process-earthquake. It gives a general explanation of earthquakes, reviews the situation in Utah and what could happen in a major earthquake. This is followed by an earthquake safety session. Follow-up activities on earthquake safety are left with the classroom teacher. These were adapted from CALEEP materials to reflect the Utah scene.

CONCLUSION

Earthquakes are an international problem that require everyone's attention. An on-going earthquake education program incorporated into all grade levels will provide a continually developing foundation of science and safety information for students and staff tailored to their learning and emotional needs. Students of all ages must be able to take self-protective actions during an earthquake. Factual information on the science of earthquakes will help place the need for learning safety actions within the context of naturally occurring phenomena like weather, will help dispel common misperceptions that could inadvertently result in physical and emotional harm, and will help build a future population of knowledgeable adults capable of making decisions concerning appropriate policies needed to reduce earthquake hazards.

References

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