EARTHQUAKE Drill:
A Critical Skills Exercise

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Abstract

Earth science students at Salem High School have participated in an environment of critical skills. Events are student centered, learning stresses both process and curriculum content, and the foundation for activity is problem-solving projects. This particular project had students designing and rehearsing part of an emergency management plan in response to a hypothetical earthquake affecting Salem, NH. Students assumed the roles of town officials in a three-hour drill held in Salem's Emergency Operations Center (EOC). The drill was sponsored by the town of Salem and the New Hampshire Office of Emergency Management. Project origin, planning, performance, and follow-up are detailed in this paper.

Introduction

For seven months students in this class spent more than 100 hours not only learning about specific topics in Earth science but also learning specific strategies for learning and working together. In March, as our plate tectonics unit progressed, the time to apply our learning had arrived. A project was designed in cooperation with our town's emergency management director and the New Hampshire Office of Emergency Management.

In this project students were to design, document, and use a hazard plan to be added to Salem's Emergency Management Plan for earthquake response. Students did extensive research and documentation, preparing a plan and also preparing themselves to play roles as decision makers in a disaster. The teacher, the emergency management director, and Office of Emergency Management staff members met and communicated many times to finalize the details.

The actual drill, held in Salem's Emergency Operations Center (EOC), greatly surpassed all expectations. Students handled crisis after crisis as part of a three-hour drill that included mass destruction, dam failure, utility outages, looting, hospital closings, and multiple evacuations. Groups of students rotated through three one-hour shifts filling various roles in turn, including those of the school superintendent, reporters, and selectmen. There was confusion and near hysteria as a myriad of details crowded the EOC. Students struggled at times to prioritize and solve problems. All the participants and observers came away with a new respect for each other and a new appreciation of the need to be prepared for the worst.

How It All Began

Teaching in this class proceeds from the philosophy that learning is a very complex behavior. Learning is different for each individual, and schools need to recognize these differences. Schools also need to teach not only the "what" but also the "how" of learning. With this in mind, these 96 people were provided a student-centered environment that made them ultimately responsible for their learning both as individuals and as a group. Students spent many class periods doing activities that provided experience with various learning styles. Projects were used to create concrete and abstract opportunities for learners, including reading, writing, coordinating, prioritizing, and communicating.

Emphasis is placed on the belief that there are often many viable solutions to a problem. For this reason, creativity is strongly fostered, as students are urged to produce quality work from their own base of knowledge and experience. The teacher is not the "fountain of knowledge." Students must find their own answers that they can support fiercely and intimately. Guidance and direction are given in the form of specific teacher questions. As students gain experience and comfort completing curriculum-based projects in this student-centered class, they begin to take more control of their education, needing less teacher input. With greater student responsibility, the teacher's goal is to balance content and process so that each remains equally valued in learning.

Earthquake in Salem, NH

So why dabble with earthquakes, not to mention the town's Emergency Management Plan? Because high school students are interested in earthquakes. Earthquakes are unpredictable, damaging, and loud—characteristics admired and even shared by many teenagers. Moreover, the teachers saw a need for earthquake education, preparedness, and response within the community.

In preparation for this major project, classes throughout the year dealt with process strategies and critical skills. Skills including decision making, problem solving, communication, cooperation, and documentation were addressed, rehearsed, refined, and incorporated into our classes. Additionally, students carried out many short-term projects in the field of plate tectonics and seismology. Specifically, students researched, modeled, and demonstrated types of seismic waves, seismic forecasting, hazard assessment, and New England's seismic history.

The next step in the project involved a contact with the person in Salem responsible for emergency management. The teacher had to determine if the anticipated needs existed and whether or not direct community involvement was possible. Salem's fire chief, who also serves as its emergency management director, acknowledged a void in the town's disaster response and was completely open to student input and community cooperation. As the teacher and the director discussed their needs, the project evolved into what they hoped would be a truly meaningful experience. Ninety-six of Salem's teenagers might permanently and positively affect their community.

The teacher expressed the following goals:

A. Students will develop and implement a solution with an educational component to a real problem in our community. They will:

1. do community-based research
2. incorporate many information-gathering techniques
3. use a maximum number of resources
4. use preexisting models and/or plans where appropriate

B. Students will select, implement, and refine certain process skills, such as decision making, problem solving, communication, cooperation, and documentation.

C. Students will be able to describe all major theories on plate tectonics as well as how those theories relate to earthquakes.

D. Students will be able to describe New England's earthquake history and its susceptibility to future seismic activity.

E. The adults will empower students to come up with their own plan in an open environment with a minimum of restrictions.

Planning, Planning, and More Planning

The director suggested a drill that would test the students' solutions as a way of summing up and evaluating the project. This drill would not only satisfy the teacher's desire to test students, but also provide a rehearsal of the town's Emergency Management Plan. The teacher and the director outlined the town's need for a hazard plan and discussed the specific ways in which students might meet that need. A time and date for the drill were set, and a letter to the students was drafted, recognizing their recent experiences in these areas and requesting their aid.

The next task was kicking off this 15-day extravaganza by arranging for expert speakers to come into the school. Issues discussed included seismology, engineering, hazard assessment, emergency response planning, and plan implementation. All of our guest experts graciously supplied printed materials to supplement their presentations.

On kick-off day, the educators and the experts decided students needed additional guidelines to properly design a hazard plan. The design of the plan was separated into five areas—communication, evacuation, hazard assessment, private resources, and public resources. As the first few days passed, students struggled to prioritize the components of the problem and divide up responsibilities. The teacher carefully guided students by questioning them and challenging them to use skills and knowledge they had already developed.

Meanwhile, the director scripted the drill, provided the teacher with the roles and titles students would assume during the drill (see list below), and secured access to a wide variety of resources. The resources included a college text, Federal Emergency Management Agency (FEMA) pamphlets, and a blank hazard plan illustrating plan design. Also made available were the telephone numbers of the town's department heads and of state and regional emergency management personnel, and lastly, the most precious resource of all, personal attention and dedication. The New Hampshire Office of Emergency Management and its natural hazards program specialist also provided generous amounts of both time and materials.

EOC Town Officials and Staff Roles

TOWN OFFICIALS	EOC STAFF
Chairman, Board of Selectmen	Message Loggers (2)
Members, Board of Selectmen (4)	Message Runners (2)
Town Manager	Updater, Status Board (1)
Emergency Management Director	Radio Communications (2)
Fire Chief	EOC Security (2)
Police Chief	EOC Logistics (2)
Public Works Director	Public Information Officer
Health Officer	Reporters (3)
Chief Building Inspector	
Director of Human Resources (Welfare)	
American Red Cross Director	
Superintendent of Schools	

As the project continued, the teacher noticed an ever-increasing level of student anxiety and misdirection. Therefore, the teacher and the director arranged for a debriefing of the project's progress. The students presented their ideas and findings to a panel consisting of the director, educators, and the New Hampshire natural hazards specialist. The panel was able to give students valuable feedback on their plan's strengths and weaknesses. This day-long debriefing also allowed students a chance to look at the project from a critical point of view, breathing new life into their design and implementation efforts.

At the beginning of the second week, the teacher finalized student sign-up for the roles they were to assume in a three-shift rotation. Each student selected (1) a decision making role, where he or she would play an active part in the Emergency Operations Center (EOC), and (2) an EOC staff role or a role with rescue equipment and media presentations. Each student also had to identify one shift during which to start a journal, recording not only observations of the drill's varied actions and reactions, but also an introspective analysis of the project's progression from start to finish.

The director coordinated the attendance of the town's department heads, the school superintendent, the American Red Cross representative, a utility company representative, and the media, as well as state and regional emergency management officials. The director and the teacher finalized details and made arrangements for physically disabled and motivationally disabled students, school and community rules implementation, lunch, and debriefing.

It's D-Day!

At 8:30 a.m. on D-Day (Drill Day), students anxiously gathered materials and boarded the bus to Salem's EOC, not knowing quite what to expect. Upon arrival at the Main Street fire station housing the EOC, students heard building rules and consequences, dropped off their coats, and positioned themselves for the first shift of the drill. With Salem's youth in place as fire and police chiefs, building inspector, school superintendent, radio operator, message runners, EOC security, and newspaper reporters, the EOC opened and the drill began.

The script for the day explained that the EOC had been opened in response to an earthquake at 7:50 a.m., measuring 7.5 on the Richter scale and centered in nearby Hudson, NH. With Salem's adult department heads as advisors, students enacted their plan, prioritizing needs, communicating with counterparts, and solving problems, all while using the town's minimal remaining resources as judiciously as possible.

An excerpt from the drill script details the crisis students were reacting to.

SHIFT CHANGE—STATUS REPORT

It is now 8:00 am (the second morning).

During the night, the public works department began repairs on the known broken water mains. The water towers are back up to capacity, but water service is provided to only a small portion of the town (Main St./Depot area and Lawrence Rd./Cluff Rd. area).

The sewer system is completely out of service and sewerage is beginning to leak into some streams and onto roads. All power in town went out for most of the night and is beginning to come on in sections. Cable TV is still out. The cracks in the dam at Arlington Pond appear to be worsening.

The evacuation center has housed approximately 200 people who are in need of food.

The Police Department spent a long night dispersing looters and making arrests. Approximately 20 people are in custody.

The Fire Department responded to several building collapses, two house fires, numerous downed power lines, and 15 ambulance calls. Most of the patients were taken to a temporary first aid station.

Two relatively minor aftershocks were felt during the night.

Decisions are made, aid is rendered, and nerves are wracked as each shift struggles with a seemingly endless onslaught of high-priority problems. At times, the EOC becomes a jumble of noise and confusion. Internal communication deteriorates and priorities temporarily blur. Selectmen try to solicit information from the building inspector, only to find him tied up with both the public works director and the health official. Finally, the emergency management director shouts for order, quieting the din and returning the EOC to a semblance of organization. After 180 minutes, simulating 24 hours of emergency responses highlighted by a telephone call from the Director of FEMA, Mr. Stickney, the drill concludes with a press conference.

As we await the arrival of lunch, all participants are relieved, excited, exhausted, and slightly saddened to know the project has reached its end. Students share the disasters and the responses of each shift. Some write feverishly in their journals, not wanting to forget a single moment. As the 30 pizzas arrive, students and staff alike enjoy a carefree lunch and conversation.

With lunch cleared away, the group assembles for the anticipated critique and debriefing. Town and state emergency management officials have many kind words for the students, followed by praise from Salem's emergency management director and the teacher. In spite of the positive input, students decide that their hazard plan can be improved, and request permission to keep the document for that purpose.

At 1:15 p.m., the students, document in hand, say their good-byes and their thanks as the teachers and directors shake hands. After a short ride, the once and future emergency managers are back in school, heading off to their last-period class. These 96 young teens have had the experience of a lifetime, gaining a priceless perspective on their community and themselves.

Project Strengths and Weaknesses

The success of the project far exceeded all expectations. Students were able to not only synthesize a plan for dealing with a natural disaster, but also put their plan into action. There were some areas of concern, however.

Even though the plan allotted 15 decision-making roles, representing town officials, and another 15 staff roles in the EOC, there were, several students who had to double up in order to participate in the EOC's operation. The EOC was always overcrowded with students, adult advisors, state and regional observers, and media.

The strengths were numerous. This activity was truly student centered. Students took the initiative in researching and preparing the plan, several times even meeting after school and on weekends. Additionally, students had to make dozens of community contacts to gather materials and information. There was a rush of positive public relations for both the school and the town of Salem. Print media from Lawrence, MA, and Salem, NH, as well as TV news from Manchester, NH, covered the drill. Most satisfying to the teacher, the students ended the experience still wanting to do more, as they communicated through their lengthy and detailed journals.