Developing Decision-Making Skills for Uncertain Conditions: The Challenge of Educating Effective Emergency Managers

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ABSTRACT
Effective decision making under conditions of uncertainty involves the ability to recognize risk, formulate strategies for action, and coordinate with others in an effort to bring an incident under control quickly. Learning to make decisions effectively in urgent, uncertain conditions is not easily achieved in a classroom setting. Educators face a particular challenge in creating a learning environment in which students can develop this ability in preparation and/or support for careers in emergency management. The Scholarship of Teaching and Learning (SoTL) suggests that higher-level thinking skills facilitate the kind of problem-solving skills and subject mastery helpful to decision making under conditions of uncertainty. A content analysis of syllabi on emergency management demonstrates that instructors, in practice, focus disproportionately on lower-level thinking skills. We present a set of propositions informed by SoTL and the study of cognition to design curricula that facilitate the development of higher-order thinking skills that support decision making under conditions of uncertainty.

CREATING A FORUM FOR LEARNING PROBLEM-SOLVING SKILLS
The key quality that distinguishes effective from less effective decision makers operating under conditions of uncertainty is the judgment they bring to bear.

Keywords: Decision-making skills, emergency management, higher-order thinking

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under a novel and complex set of conditions (Comfort, 1999; Klein, Orasanu, Calderwood, & Zsambok, 1993; Weick & Sutcliffe, 2007). In situations characterized by uncertainty and stress, well-known rules may not apply, resources may be scarce, and the usual means of support may not be available. Yet, the decision maker has legal responsibility for action and so must act under conditions in which lives may be at risk, high-value property may be at stake, and chances for escalation of damage may be high. In such settings, a decision maker will draw upon a stored base of knowledge about the context, constraints, personal experience, and immediate opportunities for action to fashion a strategy that works to the best of his or her capacity (Klein, 1998). The decision may not always be optimal, and it may not always be efficient; but if lives are saved, stability of operations restored, and the incident brought under reasonable control, the decision is considered to be effective (Klein et al., 1993).

Learning to make decisions effectively in urgent, uncertain conditions is not easily achieved in a classroom setting, using traditional lecture formats. In many respects, the basic assumptions of traditional classroom learning do not fit the requirements for developing problem-solving skills (Kiltz, 2009). In a traditional lecture format, the basic assumptions are that the instructor imparts knowledge to the students through readings and lectures and that the students learn as individuals to comprehend the material they have been given. Problem-solving skills in emergency management, rather, require several different levels of intellectual activity (Collins & Peerbolte, 2012).

We argue that emergency management courses in higher education currently focus on lower-level thinking skills that, while useful to developing a foundation for decision making capacities, do not necessarily lead to higher-level thinking skills. Scholarship of Teaching and Learning (SoTL) research demonstrates that higher-level skills are vital to problem solving, critical thinking, and achieving “mastery” within a domain. We present a set of propositions informed by SoTL and cognition research to improve the effectiveness of emergency management curricula in higher education.

**Strategy to Achieve Higher-Level Learning**

The ability to navigate uncertain, stressful situations requires multiple skills. How should instructors facilitate these skills in a classroom setting? Research from SoTL offers a strategy to achieve what is referred to as mastery. Students develop mastery over time as a result of a three-step process of learning as visually demonstrated by Figure 1 (Ambrose, Bridges, DiPietro, Lovett, & Norman, 2010). In the first step, students acquire specific component skills that underlie their area of study. Second, students practice integrating these skills in various combinations depending on the context and guided by the instructor. Students at this point do not yet achieve mastery. Mastery is achieved when students demonstrate the ability to know when to apply component skills in different combinations without the instructor’s intervention. This third step, or transfer,
represents “the application of skills (or knowledge, strategies, approaches, or habits) learned in one context to a novel context” (Ambrose et al. 2010, p. 108). These three steps used to achieve mastery provide the foundation upon which to organize a set of teaching and learning activities aimed at training effective decision makers.

Figure 1.
Ambrose’s Elements of Mastery

Assessment of Current Instruction in Emergency Management With Learning Needs

How does this strategy of mastery compare with current instructional practice in emergency management? This concept is difficult to measure, but one means is to review what instructors do in their courses. Building on Bloom’s (1956) taxonomy, Anderson and Krathwohl (2000) lay out six levels of learning: remembering, understanding, applying, analyzing, evaluating, and creating. Each level represents a step in a cognitive process that increases in difficulty as a student first acquires knowledge and then moves on to application and finally to integrating
various pieces of knowledge to create new ideas. To ascertain the degree to which instructors distributed their learning objectives across these levels, we conducted a content analysis of 29 syllabi commissioned by the Federal Emergency Management Agency (FEMA).

FEMA and National Association of Schools of Public Affairs and Administration (NASPAA), in 1984, created a working group of scholars focused on hazards research. Efforts by this group eventually led to the development of the FEMA Higher Education Project (Comfort, Waugh, & Cigler, 2012). Over the past decade, the project commissioned curricula for dozens of emergency management courses by top scholars in the field. FEMA provides these syllabi and lesson plans at no cost to universities. Although this sample is not necessarily a definitive representation of the larger teaching community, it does represent a set of professional examples that are developed, posted, and used by instructors throughout higher education.

Figure 2 demonstrates that instructors rely disproportionately on lower-level learning objectives for their courses. Of the 342 objectives posted, 77.5% (265) were related to remembering or understanding. It is logical that most of these objectives would fall into the lower-level categories, because the attainment of higher-level thinking skills first often requires lower-level skills (Anderson & Krathwohl, 2000). However, many of the FEMA courses failed to expect even one higher-level skill. Mastery as outlined by Ambrose and her colleagues (2010) requires application and other higher-level learning skills. Of the 29 courses, only 13 (44.8%) posted application objectives, 19 (65.8%) analyzing, 9 (31.03%) evaluating, and 6 (20.7%) creating.

The FEMA courses do promote basic knowledge about the domain of emergency management: the laws, policies, and practices that characterize the field; the major actors and their responsibilities; and the major risks encountered in daily practice. This rudimentary level of understanding for emergency management can indeed be taught effectively in classroom settings or largely acquired by individual students working on their own. In practice, the challenge is that the knowledge developed in this format likely will get them only through daily, routine operations in well-structured situations with limited uncertainty. Emergency management requires more dynamic, flexible approaches to problem solving than the bureaucratic approaches that had long characterized the system (Neal & Phillips, 2007). Phillips, Klein, and Sieck (2004), for example, suggest that expertise is built not on checklists and memorization, but through deliberate, experienced-based practice in which mental models are developed and enhanced through the introduction of multiple scenarios, contingencies, and varied repertoires of action.

Given the objective of mastery of the field of emergency management, the key question confronting educators in emergency management programs is whether their teaching and learning activities enable effective decision making under conditions of uncertainty. The goal becomes enabling students to move through different levels of problem-solving skills (Savin-Badin, 2000). The primary goals, in practice, of life safety, incident stabilization, and protection...
of property and resources for the community represent the overall mission of emergency managers, and they may require reorganization of routine activities to meet them under changing conditions (Howitt & Leonard, 2009; Sylves, 2008). Yet, it is essential that students understand the importance of moving beyond laws, policies, and procedures to learn how to operate within this context as functioning decision makers.

Keeping the end goal in mind becomes the guiding principle in recognizing risk and searching for information to validate a strategy of action in uncertain conditions. Meeting this threshold requires interaction with other experts, groups, and sources of information, such as knowledge bases or real-time reports of changing status of the community at risk. It means learning which sources of information are valid and which are not, and using valid information to build a strategy of action. This approach requires thinking in a broader context, mindful of the impact of one unit’s action upon others, and the reciprocal effect that the actions of others will have on one’s own group. Only by developing sufficient skill in interacting with others and searching a wider set of knowledge sources to achieve a common goal do decision makers pass this threshold and advance to the next level of problem solving that is critical in managing large-scale, extreme
events: creating a common operating profile for the multiple organizations and jurisdictions that are involved in response operations.

In what ways does this approach differ from traditional approaches to education and training for emergency managers? The primary difference is the focus on process rather than structure. Further, the means of acquiring skills in process differ from those involved in learning the terms, organizational procedures, and responsibilities that provide structure to professional practice. Both are important, but the acquisition of process skills involves developing a mental model that can accommodate uncertainty and is open to new information, correction of error, and rapid revision of strategies of action based on valid information. Traditional approaches to emergency management have focused, rather, on comprehending and analyzing the structure of emergency management and emphasizing organizational charts, prescribed roles, detailed procedures, and checklists for performance under specific conditions. This approach works well in routine, well-structured, stable conditions, and most emergency management training programs have adopted it as a means to increase the level of professional performance among disparate organizations or organizations with large numbers of voluntary personnel, such as fire departments in most communities outside major cities. For example, the National Incident Management System (NIMS) represents an effort to standardize emergency management training and procedures across all levels of jurisdictional operation. Although this objective is certainly worthy and has contributed to the wider acquisition of shared knowledge regarding procedures of emergency management, the instruction has emphasized structure over process (e.g., communication, networking, decision making), largely because it is easier to teach in classroom settings (Buck, Trainor, & Aguirre, 2006). The result, in many cases, has increased the rigidity of practice in extreme events, making emergency personnel less attentive to indicators that fall outside the prescribed rules, less able to adapt to changing conditions, and more vulnerable to organizational failure in shifting, uncertain conditions (Wise, 2006).

Traditional approaches to training have in fact attempted to focus on process, but this is difficult to do effectively. Tabletop exercises, for example, are relatively simplistic models that do not address the complex sets of interdependencies that affect and inhibit action in a rapidly evolving incident. Consequently, such exercises rarely change the existing mind-sets of emergency personnel involved in them. Instead, they often reinforce previous practice and exclude novel contingencies. Functional and full-scale exercises provide more complexity (McEntire & Myers, 2004). The classic example of a major training exercise that failed to attune the existing mental models of emergency managers at multiple jurisdictional levels to unanticipated extreme conditions was the Hurricane Pam exercise, conducted by FEMA in Louisiana in July 2004. The Hurricane Pam exercise used the scenario of a major hurricane striking the vulnerable city of New Orleans (FEMA, 2004), requiring timely action and coordination among all four governmental jurisdictions for effective response.
The exercise involving emergency personnel from federal, state, parish, and city jurisdictions was considered highly successful; but on August 29, 2005, only 13 months later, the actual Hurricane Katrina followed nearly exactly the same scenario and relentlessly revealed the inability of all four jurisdictions to coordinate their actions to reduce risk and bring the incident quickly under control. Clearly, different approaches to education and training in emergency management are needed.

**Theoretical Lenses for Changing Conditions**

Other theorists have considered the problem of decision making under uncertainty, and their insights inform our understanding of the relationship between creating a sufficient structure to hold and exchange information while also having sufficient flexibility to adapt to changing conditions (Kauffman, 1993). Edwin Hutchins (1995) documented the process of distributed cognition in group decision-making processes that pooled knowledge from different sources to inform complex decisions. Hutchins also acknowledged the role of instruments used to assess the changing environment in providing real-time information directly to the decision makers. Gary Klein and his collaborators (Klein et al., 1993) note the importance of “recognition primed decision making” used by experienced managers, and the role of experience in developing a repertoire of strategies that could be combined and recombined to fit emerging situations. Steven Bankes, Robert Lempert, and Steven Popper (2003), in a sixth edition of their book, use computational simulation as a method of exploring plausible strategies for anticipating complex scenarios in uncertain conditions. Although each of these theorists addresses key aspects of decision making under uncertainty, educators face a particular challenge in creating the environment in which students can develop the skills of adapting informed processes within a structured environment under rapidly changing conditions.

One approach to this dilemma is to identify the skills needed for effective decision making under uncertainty and, mapping backward, to design learning tasks that facilitate the development of these skills. In earlier work, Comfort (2007) identified four skills as essential to decision making under uncertainty: cognition, communication, coordination, and control. These skills are cumulative; each skill depends upon the preceding skill. For example, communication depends on cognition; for without awareness of risk, emergency personnel would not communicate the threat of risk. Likewise, coordination depends upon communication, for without effective communication, other actors will not be able to coordinate activities among multiple actors. In turn, the fourth skill, achieving control in complex, dynamic settings, depends on the third, coordination of collaborative activities among multiple actors. Of the four requisite skills, the most difficult to develop is cognition, which requires a mental model of how the system in question “ought” to operate (Klein et al, 1993). The skill lies in distinguishing any departure from that model as an “anomaly” that warrants attention. The
ability to recognize anomalies and use them to question the existing state of operations leads decision makers to assess risk and consider what might be alternative strategies of action in a given context (Weick, 1995). The anomalies may be vague, ambiguous indicators that, separately, may not constitute a threat, but taken together, would be recognized by an experienced manager as conditions leading to danger. Developing the skills needed to recognize risk requires building a cumulative base of knowledge about a certain area of operation that allows the decision maker to distinguish valid from invalid indicators of possible dysfunction.

Building Skills for Decision Making Under Conditions of Uncertainty

The classic question for educators is how to design instruction that can substitute for experience in building problem-solving skills for students. At best, such instruction can enable students to develop a systematic knowledge base regarding the set of interacting conditions for a given community that requires continual monitoring for possible risk. These conditions would include, minimally, (a) an assessment of risks, given the physical, engineered, and social characteristics of the region; (b) an assessment of assets for emergency response and recovery, given the same characteristics of the region; (c) an assessment of the existing information infrastructure that allows the rapid search, exchange, and analysis of information regarding emerging risk; and (d) knowledge of who has the capacity to act upon informed judgments regarding risk with what degree of authority and competence.

The four functions of cognition, communication, coordination, and control are linked through their progressive dynamic toward action. The goal of problem solving in extreme events is to build a “common operating picture” among all participating actors, so it is essential to identify who those actors are likely to be in any given situation, and second, to recognize their existing constraints on action. Then, the dynamic toward action can be understood by students as it evolves in a realistic setting, coached by the instructor to facilitate student advancement through the sequential set of thresholds of learning. Each of these four sets of skills can best be fostered by different learning activities, and if possible, in different actual or virtual settings.

Cognition. Returning to Herbert Simon’s (1997) adage that “we can only create what we already understand,” the first step to building the capacity to recognize risk is developing a detailed understanding of the context of operations for known emergencies. To do so means identifying key indicators for change in a system, which implies sufficient knowledge of the system’s critical functions to recognize which indicators, or combination of indicators, would impair system performance, if found in practice (Klein et al., 1993). Determining the discrepancy between how the system should function in desired operating conditions and how it actually functions in practice leads to cognition of risk in a changing environment.
Communication. Once risk has been recognized and identified as a threat, the situation moves from individual to group action. Students then need to learn how to communicate risk to individuals, organizations, groups, and jurisdictions that share the risk as well as to agencies that can mobilize response to reduce the risk. This task requires the “capacity to create shared meanings among individuals, organizations, and groups” (Comfort, 2007, p. 194) that will enable them to take appropriate action to reduce their own risk as well as mobilize timely response for the whole community. The capacity for timely, valid communication of risk depends, as stated earlier, upon the accuracy and timeliness of recognition of that risk as well as the willingness to update old information and correct errors based on obsolete judgment (Doyle, 1979).

Coordination. Skills of coordination depend upon both the validity of the information being communicated and the residual knowledge and skills of each of the participating actors. Coordination means the ability to articulate a common profile of risk for multiple actors, so that each can align his or her actions with those of other actors to achieve a shared goal (Comfort, 2007; Koppenjan & Klijn, 2004). The timeliness and ease of coordination depends upon the level of shared cognition of risk achieved through valid communication of risk to the participating actors and wider community.

Control. The intended goal of emergency managers is to bring the incident under control, or to a stable, non-escalating state, through the proper integration of critical tasks performed simultaneously by multiple actors (Comfort, 2007; Waugh & Tierney, 2007). This effort depends on each of the preceding functions: cognition of risk by at least one actor in the operating system; communication of that risk to all other actors in the system and to external actors who have the capacity and responsibility to support the system with resources and relevant knowledge, and further, coordination of action among multiple actors simultaneously in the emergence of a coherent response system. In sequential fashion, the emerging response system expands through the information processes used to drive the system. The degree of timeliness, effectiveness, and efficacy of the emerging response system depends on the degree to which each of the three previous thresholds for cognition, communication, and coordination have been achieved for that specific region.

A Teaching and Learning Strategy to Facilitate Effective Decision Making

Students need to grasp sufficient information about the domain of emergency management that they recognize tensions inherent in uncertain situations and understand that the process of prioritizing actions often means giving up preferred outcomes to achieve primary goals (e.g., life safety, incident stabilization, and protection of property). The cumulative acquisition of knowledge and experience,
however, requires practice. Following the basic steps to achieve mastery (Ambrose et al., 2010) and informed by research on cognition (Klein, 1998; Comfort, 2007), we outline a set of learning activities to facilitate effective decision making in the field of emergency management. Table 1 illustrates the order in which we suggest these learning activities be tested. We propose that these activities will facilitate improved decision making under conditions of uncertainty.

Table 1.
Structures Teaching and Learning Activities to Facilitate Effective Decision Making

<table>
<thead>
<tr>
<th>Elements of Mastery</th>
<th>Teaching and Learning Activities</th>
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<tbody>
<tr>
<td>Acquire component skills</td>
<td>Describe the structure of the emergency management system</td>
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<td></td>
<td>Identify hazards</td>
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<td></td>
<td>Monitor change</td>
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<td></td>
<td>Identify vulnerability</td>
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<tr>
<td>Practice integrating skills</td>
<td>Link hazards with vulnerabilities</td>
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<td></td>
<td>Link hazards and vulnerability to appropriate strategies to reduce risk</td>
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<tr>
<td>Know when and how to apply skills (Transfer)</td>
<td>Alta Madre and Rim Sim exercises</td>
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<td></td>
<td>Watch-floor exercise</td>
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<td>Emergency operations center (EOC) exercise</td>
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Component Skills

Learning activities focusing on one core skill at a time represent an initial foundation for learning. Students experience less difficulty in learning isolated, single tasks as opposed to more complicated, intensive skills. Integrating more complex skills places heavier cognitive loads on students, because these skills require more attention and focus. As the demands of a complex task increase, performance and learning suffers as student focus dissipates (Ambrose et al., 2010).

Students enter the classroom with varying backgrounds and different levels of knowledge. In an MPA program, for example, classes often consist of a mix of pre-professional students right out of college and mid-career professional students who already have experience but are looking for ways to enhance it and gain a better appreciation of the administrative world in which they operate. Identifying a student’s level of knowledge at the beginning of the semester offers instructors the opportunity to offer remediation or background information necessary for promoting higher levels of learning. Students may not have requisite knowledge of intergovernmental relations, federalism, or other key concepts. Also, identifying students with high levels of experience and knowledge enables the instructor to empower those students to be a resource for others early in the semester.
We begin our instruction with the objective to develop basic knowledge and comprehension skills (e.g., describing the legal and organizational structure of emergency management). We move on to facilitate two key skills: identifying hazards and vulnerabilities using multiple indicators as guides to recognize changes and anomalies.

Describe the structure of the emergency management system. Students need to grasp basic knowledge about the domain of emergency management in order to organize subsequent learning within that broader context. Most university courses focus on this learning objective. They explore the laws, policies, and practices that characterize the field. As outlined earlier, this objective is indeed a critical first step to our goal of developing decision-making capabilities. The ability of a student to identify and describe the major actors in this operating environment and their responsibilities create the framework in which students structure an initial conception of a common operating picture.

Identify hazards. The initial formulation of a common operative picture depends not just on the major organizations involved but also on the timely and accurate recognition of risk. This step may require assigning students a specific geographic location exposed to risk. The key task is to engage students in developing the capacity to recognize emerging risk rather than to discuss risk in abstract terms (Comfort, 2007). In emergency management, the risk of a hazard occurring and the vulnerability of people and property to that hazard create a fundamental external problem. A key skill set exhibited by practicing emergency managers is the ability to identify critical indicators that distinguish risk from otherwise normal, safe conditions. This function represents the initial step in developing what practitioners refer to as situational awareness.

Monitor change. Monitoring the status of critical indicators then allows students to track the performance record of the system and note significant discrepancies from expected performance. It further requires sufficient understanding of the structure of the operating system, so that students can identify the conditions and processes that threaten its continued operation.

Identifying and later retrieving from memory a diverse array of indicators and hazards that exist across jurisdictions represents an initial key learning objective. Earthquakes, floods, hurricanes, winter storms, and human-made incidents make up a handful of potential threats to explore. This is a lower level of thinking (Anderson & Krathwohl, 2000; Bloom, 1956) that can be facilitated through traditional teaching and learning activities (e.g., lectures and directed readings). Access to historical data online, for example, visually demonstrates the ubiquitous nature of hazards across the globe.
The inability to distinguish high levels of risk and to take action to mitigate that risk, in practice, precipitates disaster situations (Comfort, 1999; D. J. Johnson, 2006). The ability to recognize risk can be facilitated by observation, intuition developed through experience, and technologically sophisticated systems (Comfort, 2007; Klein et al., 1993; Ling, Znati, & Comfort, 2010). Both practitioners and academics develop and maintain several open source indicators used to recognize risk. The National Oceanic and Atmospheric Administration (NOAA), for example, maintains descriptions of a variety of hazards as well as historical information on past incidents and indicators of current risk.

Even experienced emergency service personnel operate in silos on occasion, whether the silos are based on discipline or geographic location. Learning activities that expose students to multiple indicators and to the science that underlies those indicators help break down the silos that students will experience in their professional roles and facilitate an all-hazards approach to emergency management. This learning activity empowers students to actively seek out multiple sources of data upon which to draw initial conclusions. In-class discussions, student presentations, and short papers all enable students to match hazards with appropriate indicators and identify baseline evaluative criteria for each indicator.

We now have unprecedented access to both real-time and historical data on risk. Instructors and students can access National Weather Service (NWS) data and monitor weather conditions in class. They can locate wildfires with NOAA’s Satellite Fire Detection program or monitor flood risk across the United States. And they can monitor seismic activity around the world with the U.S. Geological Survey’s “Real-time Earthquake Map.”

Identify vulnerability. After (or as) students identify different types of hazards, a coinciding learning objective is to recognize the vulnerability of people who face risk. Again, students with experience in the emergency services will demonstrate previous knowledge in this area. However, they are likely also to be limited in their scope and interest based on their discipline and geographic area. Three types of vulnerability—social, built, and geophysical—require time and attention in the classroom (Mileti, 1999).

Social vulnerability speaks to the level of susceptibility that a population exhibits to a threat. For example, the assumption is that poorer communities with high elderly populations are more vulnerable than others. U.S. Census data provides a means for an initial quantification for this category using metrics based on income, education, and other variables (Cutter, Boruff, & Shirley, 2003). Learning activities that require students to use U.S. Census data to identify particularly vulnerable communities within their region help reinforce the concept.

The built infrastructure, on which people in every community rely to maintain daily, normal life, including highly technical systems, creates a distinct vulnerability that often interacts with social and geological vulnerability to exacerbate risk to a
community. Housing, transportation systems, public utilities, and other critical systems make up the built environment (Mileti, 1999; D. J. Johnson, 2006). Brainstorming sessions in class or homework assignments can be used to identify the critical infrastructures necessary to maintain basic services in a community. That exercise will enable students to recognize our dependence on key institutions and systems. Geophysical vulnerability represents varying levels of risk based on an area’s geophysical surroundings, that is, soil composition, topography, seismic risk, and waterways as well as weather patterns inherent to a particular area (Mileti, 1999). Lectures and directed readings can facilitate the recognition of these natural systems and the process of risk analysis used in practice to measure vulnerability.

**Integration**

Complex incidents demand not only multiple skills from emergency managers but also the ability to apply those skills in combination, and sometimes in situations perhaps not yet experienced by the emergency manager. As students develop separate sets of skills, they are then prepared to practice integrating those skills in different combinations. Several teaching and learning activities aim to integrate component skills.

**Link hazards with vulnerabilities.** Students should recognize that an actual hazard is not the main concern of an emergency manager, nor is a particular vulnerability. Instead, the main concern is the interaction between the hazard and community: the damage or disruption that a hazard inflicts on our social, built, and geophysical systems. To put it another way: If a tree falls down in a forest and no one hears, there is no immediate issue. If a tree falls down in a forest and knocks down a power line that leads to a disruption in the next town, including the local hospital, then it is matter of concern. Linking hazards with vulnerabilities in order to identify the potential interdependencies among geophysical, built, and social systems that lead to loss of life, property damage, and disruption of necessary services represents a key learning objective. This type of skill set can be facilitated by analyzing historical case studies. Identifying incidents based on hazard type and framing a set of questions with the intent of matching hazards with vulnerabilities allow students to recognize cause-and-effect relationships.

**Link hazards and vulnerability to appropriate strategies to reduce risk.** Once risk is recognized, effective emergency managers develop strategies of action to reduce that risk. The identification of appropriate resources, organizations, and people needed to mitigate and/or respond to that hazard represents an important step. Learning activities in which groups take on the role of emergency support functions (ESFs) allow for students to identify appropriate resources, communicate need across simulated organizational boundaries, and begin coordinating possible cooperative activities.
Transfer

Knowing where and when to apply skills without guidance represents the critical point at which a student achieves mastery over a subject (Ambrose et al., 2010). Simulating decision points in which uncertainty and stress strain a person’s cognitive ability is a key task of an instructor. Simulations are recognized as learning activities that facilitate higher-level learning (Silvia, 2012). We review two simulations readily available to instructors and then develop two exercises in which students integrate skills and then choose where and when to implement skills in different combinations with little to no guidance from the instructor.

**Alta Madre and Rim Sim.** We have used two readily available exercises in class, which inform our development of the additional learning activities described later.3 In an American context, Booher and Sutkus (2008) designed a simulation, “Alta Madre,” for emergency management planning and administration that structures a scenario for interagency coordination. In this scenario, multiple actors exhibit varying priorities and compete for grant allocations. The exercise incorporates a narrative of past conflict to simulate realistic political dynamics. It also recognizes the need to communicate planning decisions to the public. The exercise does not, however, develop specific measures of risk or make clear the hazards faced by the interagency system. As part of a larger set of learning activities, the simulation is indeed useful.

Another useful simulation, “Rim Sim,” integrates recovery with planning operations in an international environment (Barrett, Frew, Howell, Karl, & Rudin, 2003). The simulation models a process of negotiation between international actors working to distribute aid from abroad in a manner that effectively and efficiently spurs recovery for a hypothetical region of three neighboring nations that experienced different consequences from the same major earthquake and are exposed to different degrees of continuing vulnerability. Rim Sim also addresses risk and the goal of creating more resilient systems of built infrastructure. Particularly innovative is its use of scientific and technical information as a way to inform debate and counterbalance traditional political notions of power and authority. In both simulations, we have learned the importance, first, of student preparation beforehand to comprehend individual roles and responsibilities and, second, of the role of class-wide debriefings to promote a larger, systemic understanding of the decision space involved in the simulation.

**Watch-floor exercise.** Emergency services and management personnel experience normal administrative and operational conditions, punctuated by short bursts of extreme stress and effort. Between emergency incidents, personnel fill their time in varying ways: mitigation activities, administrative tasks, and preparation for the next incident. Increasingly, agencies monitor risk indicators more systematically to make informed, evidence-based decisions related to action. In law enforcement, for example, fusion centers at varying levels of government collect and exchange key pieces of information with other agencies. In emergency management, personnel
set up so-called watch floors to monitor risk and inform decision makers. Large agencies, like FEMA, assign personnel specifically for this function. Usually, these “watch standers” simply monitor the current status of their assigned geographic region, take notes, and distribute standard situation reports to key decision makers. However, in the event of a major incident, the watch floor serves a key function in collecting data, making an initial evaluation, and distributing that intelligence throughout the system.

On the watch floor, personnel demonstrate and integrate multiple skills such as the identification of risk, the initial development of a strategy for action, the communication of that strategy to others, and finally coordination. A weekly learning activity simulates the watch-floor experience. Assignments first integrate component skills (e.g., the identification of risk and the matching of resources) and later allow students to practice recognizing where and when to apply specific skills without guidance from the instructor.

The watch-floor exercise simulates, with varying degrees of detail and operational responsibility, scenarios in which the student receives information from the instructor that characterizes varying levels of risk and vulnerability. The student then makes a judgment based on available information and formulates a strategy for action. The exercise expands as the semester progresses to include students who represent personnel from varying emergency support functions (ESFs). As the simulation scales out, students practice communication and coordination.

**Emergency operations center (EOC) exercise.** The watch-floor exercise practices and reinforces core skills learned throughout the course. It prepares students to participate in larger-scale EOC simulations, which replicate more intensively the complexity and uncertainty of a disaster situation. By design, an EOC serves as central data hub in which agencies across jurisdictions and sections exchange information and coordinate collective response to assist on-scene personnel.

In an EOC exercise, students simulate the processes of locating and distributing resources for emergency response operations, sharing information, establishing priorities in terms of response tasking, and changing course in response to (or in anticipation of) new demands. Operating within the context of separate, yet often agencies throughout the distributed system. The objective of these teaching and learning activities is to demonstrate key component skills (e.g., recognizing risk, formulating strategies for action, and then communicating and coordinating those strategies with others), practice integrating those skills in different combinations, and apply those skills appropriately without guidance from the instructor.

Online decision support dashboards offer platforms for simulation exercises that replicate the EOC environment (T. Johnson & Summerton, 2012). At the University of Pittsburgh, we have developed a decision support system with, and for, practicing emergency managers that also lends itself to the classroom. The Java Interactive, Intelligent, Spatial Information System (JIISIS) is a working prototype that provides interactive communication and coordination scenarios that replicate risk indicators for people and infrastructure (Comfort & Wukich,
Students are asked to monitor risk indicators and match appropriate strategies for action with the demands of the external system—in our scenarios, flooding and hazardous materials (hazmat) incidents. Anecdotally, students have responded positively to the local granularity of our scenarios, which have been informed by data from a series of semi-structured interviews and surveys with practicing managers, geographic information systems (GIS) files, and actual exposure to hazards faced by local communities. A high percentage of our students have either lived in those communities or are at least familiar with them. By structuring the learning activity within the students’ home community as opposed to a foreign or fictional environment, we seek to reduce cognitive load and provide a scaffold that allows students to focus on the learning objectives and not be distracted by tertiary details (see Ambrose et al., 2011; Simons & Klein, 2007). Students are less burdened by learning new geography and names of agencies.

The replication of a complex, uncertain scenario in a structured environment is not a simple task. It requires a significant amount of consideration and preparation. EOC situation reports from actual incidents provide historical data on which to base a simulation. Practicing managers also provide potential partners to create authentic learning environments that replicate decision spaces characterized by risk and uncertainty.

CONCLUSION

Many emergency management courses focus primarily on elements of organizational structure; formal rules, procedures, and organizational hierarchy. The comprehension of these elements indeed warrants time and attention, because they form the basis for conceptualizing a common operating picture. Structure alone, however, is insufficient to inform emergency managers in practice. During incidents that cascade beyond anticipation and that demand novel strategies for action, decision making informed by experience proves to be an essential skill set. Facilitating this skill through teaching and learning activities in a classroom is not an easy task. A curriculum focused on elements of administrative process such as cognition, communication, coordination, and control and delivered through a tested strategy to achieve mastery provides a road map on which to move forward.

FOOTNOTES

1 We thank Mr. Joel Brady and Dr. Carol Washburn from Pitt’s Center for Instructional Development and Distance Learning (CIDDE) for their input and guidance regarding teaching and learning strategies.

2 “We made great progress this week in our preparedness efforts,” said Ron Castleman, FEMA regional director. “Disaster response teams developed action plans in critical areas such as search and rescue, medical care, sheltering, temporary housing, school restoration and debris management. These plans are essential for quick response to a hurricane but will also help in other emergencies” (FEMA, 2004).

REFERENCES


Developing Decision-Making Skills for Uncertain Conditions


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