ED 367 671   TM 021 108

AUTHOR   Gronlund, Wayne R.; And Others
TITLE   Realistic Exercises for Assessing Learning. I.
              Conceptual Design and Testing. Report 04-93.
INSTITUTION   Coast Guard Academy, New London, CT. Center for
              Advanced Studies.
PUB DATE   Mar 93
NOTE   36p.
PUB TYPE   Reports - Evaluative/Feasibility (142) -- Reports -
              Research/Technical (143)

EDRS PRICE   MF01/PC02 Plus Postage.
DESCRIPTORS   *Computer Assisted Instruction; Computer Simulation;
              Data Collection; Decision Making; *Educational
              Assessment; Educational Objectives; Feedback; Higher
              Education; Integrated Activities; Integrated
              Curriculum; *Interdisciplinary Approach; Military
              Personnel; Military Schools; *Motivation; *Research
              Design; Simulation; *Test Construction; Testing
IDENTIFIERS   Coast Guard; *Coast Guard Academy CT

ABSTRACT
         Researchers at the Coast Guard Academy have designed
and tested a series of exercises for assessing the development of
intellectual skills in an interdisciplinary context and providing
career-related motivation for continued learning. These exercises are
based on realistic situations that cadets might encounter as
commissioned officers in the Coast Guard. Participants must make a
series of decisions that are deliberately designed to require
integration of knowledge and skills from different parts of the
curriculum. An interactive computer format is used to make the
exercise more interesting and flexible; this format also facilitates
the collection of response data for later analysis and feedback.
Initial testing with samples of 65 and 49 cadets was followed by a
test with almost an entire Academy class (282 cadets). Early results
indicate that the exercise concept is beneficial to both students and
faculty. Appendix 1 presents the Academy's core curriculum; Appendix
2 lists the desired outcomes of an Academy education; Appendix III
provides the first exercise scenario administered to freshmen cadets
at the beginning of their first term. (Contains 17 references.)
(Author/SLD)

ERIC
Full Text Provided by ERIC

TM

Realistic Exercises

for Assessing Learning

I. Conceptual Design and Testing

W. R. Gronlund, K. A. Redig, and W. A. Sanders

Report 04-93
March 1993

Center for Advanced Studies
United States Coast Guard Academy
New London CT, 06320

REPORT DOCUMENTATION PAGE

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE March 1993	3. REPORT TYPE AND DATES COVERED

4. TITLE AND SUBTITLE

Realistic Exercises for Assessing Learning. I. Conceptual Design and Testing

5. FUNDING NUMBERS

6. AUTHOR(S)

Wayne R. Gronlund, Kevin A. Redig, Department of Science, and
William A. Sanders, Dean of Academics, U. S. Coast Guard Academy

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Department of Science
U. S. Coast Guard Academy
New London, CT 06320

8. PERFORMING ORGANIZATION

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

**10. SPONSORING/MONITORING
ACENCY REPORT NUMBER**

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

At the United States Coast Guard Academy we have designed and tested a series of exercises for assessing the development of intellectual skills in an interdisciplinary context and providing career-related motivation for continued learning. These exercises are based on realistic situations the cadets might encounter as commissioned officers in the Coast Guard. Participants must make a series of decisions that are deliberately designed to require integration of knowledge and skills from different parts of the curriculum. An interactive computer format is used to make the exercise more interesting and flexible, while facilitating the collection of response data for later analysis and feedback.

14. SUBJECT TERMS

Assessment, simulation, outcomes, realistic scenarios, realistic exercises, computer-assisted assessment, motivation, interdisciplinary assessment, decision-making, HyperCard

15. NUMBER OF PAGES
32

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

NSN 7540-01-280-5500

ABSTRACT

CENTER FOR ADVANCED STUDIES

4-93

Realistic Exercises for Assessing Learning
I. Conceptual Design and Testing

Wayne R. Gronlund, Kevin A. Redig, and William A. Sanders

Abstract:
At the United States Coast Guard Academy we have designed and tested a series of exercises for assessing the development of intellectual skills in an interdisciplinary context and providing career-related motivation for continued learning. These exercises are based on realistic situations the cadets might encounter as commissioned officers in the Coast Guard. Participants must make a series of decisions that are deliberately designed to require integration of knowledge and skills from different parts of the curriculum. An interactive computer format is used to make the exercise more interesting and flexible, while facilitating the collection of response data for later analysis and feedback.

Realistic Exercises for Assessing Learning

I. Conceptual Design and Testing

Wayne R. Gronlund, Kevin A. Redig, and William A. Sanders

U. S. Coast Guard Academy

New London, Connecticut

Introduction

The United States Coast Guard Academy is a very selective undergraduate institution whose mission is to prepare young men and women for careers as Coast Guard commissioned officers. Its highly structured 40-course academic program is divided into a core curriculum of prerequisite and general education subjects, a major consisting of 12-14 courses in one of seven available areas of concentration, and a sequence of four professional courses. Science, mathematics, and engineering basics make up a large fraction of the core curriculum, which is listed in Appendix I. This has been justified historically by the technical nature of many of the Coast Guard's missions and by the fact that all but two (Government and Management) of the seven majors are subfields of engineering, science, or mathematics.

The standard academic load is five courses per semester, with the privilege of carrying a sixth course limited to upperclass cadets who have demonstrated their ability to handle an overload. In addition to the academic program, all cadets must participate in military training, physical education, and intercollegiate or intramural sports. Extracurricular activities include club sports, instrumental and vocal music, community service, and a variety of special interest clubs. The entire student body lives in one large dormitory

and eats together in a central dining hall. With the exception of a small remedial academic program, summers are devoted exclusively to professional and military training.

Well over half of our alumni earn graduate or professional degrees in a variety of fields within ten years after graduation. For many years, their consistently high level of performance in quality graduate schools was accepted as sufficient evidence that our curriculum was serving its intended purpose. Like most colleges in our cohort, we gradually became more aware of the importance of credible assessments of our major programs. Until quite recently, however, we had given little thought to the cumulative impact of the core academic program on the personal development and critical thinking skills of the cadets. Moreover, we had no hard evidence to indicate that our general education requirements were contributing positively to long-term success and personal fulfillment.

Our concern over the impact of the general education program does not derive exclusively from aesthetic considerations. In contrast to the Department of Defense military services, the Coast Guard does not have a large civilian intellectual bureaucracy that engages in the study and formulation of policy. As a result, its senior officer corps is responsible not only for the planning and conduct of operations, but also for establishing and articulating policies that cover the full spectrum of institutional activities. Officers who have spent the middle years of their careers as operational commanders and technical specialists are expected to be versatile and articulate generalists when they rise to the upper tiers of leadership. We believe the foundations of this kind of intellectual development are best laid during the undergraduate years, given the pressure to concentrate on more narrowly professional education and training after graduation. Since an

6

overwhelming majority of the senior officers who serve in Coast Guard policy-making roles are graduates of the Academy, the intellectual values and attitudes they acquire as cadets have very far-reaching consequences.

Background of the Problem

For the past three years, every cadet experiencing serious academic difficulties has been interviewed and counseled in depth by the Dean of Academics. From the very outset, these discussions confirmed our suspicion that a substantial fraction of these students do not easily relate their educational experiences to the more general and less narrowly technical assignments they will be required to perform later in their careers. Some do not experience the intended sense of increasing personal capability as they progress through the academic program, and they often fail to acquire a proper appreciation of what they have yet to learn.

Further conversations with faculty members and more successful cadets led us to the conclusion that the concerns described in the preceding paragraph apply as well to many students who are not experiencing academic difficulties. To be sure, they are demonstrably able to solve increasingly complex and sophisticated problems within the framework of the academic disciplines as they move through the course sequences. However, the ability to apply these skills to more general tasks that transcend disciplinary boundaries has been left largely to chance. Our conversations with colleagues in other undergraduate institutions led us to believe that this perception is not unique to the Coast Guard Academy.

After a year of discussions and revisions, our Academic Council agreed upon a set of desired general outcomes of the academic program. These identify common skills and attributes we hope the cadets will acquire as a

result of the integrated educational experience. They represent the first substantive attempt to temper our preoccupation with the structure of the curriculum and devote more attention to its impact. A list of the outcomes with amplifying discussion is attached as Appendix II. By deliberate design, they are characteristics that cannot be uniquely related to the subject matter of individual academic courses. Indeed, candidate outcomes were disqualified if they were judged to be no more than restatements of specific course or major sequence objectives. It is reassuring to note that they overlap significantly with similar lists adopted by other colleges. We are now using these outcome statements as a focus for course design, faculty development, and assessment efforts. Instructors are encouraged to share outcome-related objectives with the students at the beginning of each course. Our hope is that integration of knowledge will more likely occur when both instructors and students are appropriately sensitized and more consciously steered toward the common goals of the academic program.

Two key ingredients were clearly still missing from the strategy described above. First, we needed a valid method of assessment that could measure and document the progress of our students toward the desired outcomes. Academic course grades clearly did not serve the purpose because they are too dependent on discipline-specific knowledge and abilities. Some of the outcomes lend themselves less readily to objective or quantitative measurement than others, so this presented us with a formidable design challenge. We have limited in-house expertise in the development of assessment methods that measure attitudes or aptitudes not directly related to content mastery in the traditional sense, and we are not yet wholly acclimated to the concept of interdisciplinary education.

Second, we have not done a very effective job of helping the students understand and appreciate the practical importance of a sound general education. We have allowed them to measure their progress in terms of courses passed and specific skills acquired, instead of showing them how the knowledge and abilities they have acquired will enhance their future performance as Coast Guard officers and expand their intellectual horizons. Although we have talked a great deal about the importance of instilling values of lifelong learning while teaching self-assessment and self-motivation, we have done very little to translate these words into substantive programs. This goal has important idealistic significance, since we share with all other educators the desire that our efforts have long-term positive influence on the lives of our students. At the same time, it has great pragmatic importance because it has been demonstrated repeatedly that our cadets devote their best efforts to the activities they *perceive* to be most relevant to their careers (and not necessarily to those they have been *told* are most important).

The initiative described in this paper was aimed specifically at the development and implementation of a process for responding to the questions raised above. In constructing our basic plan, we borrowed liberally from a wide range of models. These ranged from the simulation exercises used by the military and other service organizations, through the case study methods favored by many business schools, to the intellectual skills assessment concepts pioneered by Alverno College. Many ideas were integrated to develop a program that seemed most appropriate to our unique set of constraints and resources. At the same time, we believe the general concepts are applicable to a wide variety of college environments.

The General Approach

Our working concept is to design a sequence of carefully constructed exercises that will require the students to draw upon a broad range of knowledge and intellectual skills for the solution of realistic and interesting interdisciplinary problems. Fourth-class cadets (freshmen) will encounter the first event of the series soon after arriving at the Academy. The goal of this initial exercise is to demonstrate to the new students that the intellectual tools they bring with them from high school can already be applied to the solution of some non-trivial real-world problems. At the same time, it is designed to call their attention to essential skills that require further development and that can in fact be acquired or enhanced through the academic experiences of the next four years.

Follow-up exercises will be conducted at the end of each academic year. The long-range strategy is to expose the cadets to exercise scenarios that become increasingly complex and sophisticated as they progress through the four-year program, so they can gain a sense of their own intellectual growth and developing ability to analyze and solve challenging problems. For cadets in the two lower classes, we plan to concentrate on assessing the development of decision-making capabilities in situations requiring the application of standard techniques and the interpretation of established concepts. By the senior year, however, the students will be required to devise new procedures and to formulate thoughtful policy recommendations in situations for which there is no exact historical precedent. Throughout the process we hope to accumulate data on student progress toward achieving the desired outcomes (critical analysis, oral and written communication, planning and coordination, etc.).

We believe that exercises of this kind must be interesting to the students if they are to be taken seriously and fulfill their intended purpose. Accordingly, we decided to develop the exercises around the kinds of situations the cadets could expect to face in the future as Coast Guard officers. As a concrete example, we have included in Appendix III a description of the scenario we used for first-year cadets in August 1991. Student feedback from this pilot exercise strongly reinforced the importance of realism and perceived relevance as essential requirements for maximum participant cooperation and enthusiasm.

The Initial Test

At the beginning of the six-week summer indoctrination program, our freshman class is divided into four companies of 65-75 students each. The initial test exercise was conducted at the end of the summer program with a single company of 65 cadets. A second company was subjected to the same sequence of preliminary training and psychological testing, but did not participate in the exercise. We have continued to track the latter sample as a limited control group. The exercise was conducted in one day, starting at 8 AM and ending at about 4 PM, with a break for lunch. Approximately 17 faculty members volunteered to serve as monitors and observers.

Prior to the exercise, the faculty monitors were briefed on the goals, structure, and procedures of the exercise, and those who were to participate in the post-exercise debriefing of the participants received approximately three hours of specialized training. The latter session was conducted by a faculty member who has very extensive experience in conducting focused group interviews. The cadet participants were required to attend an orientation session the evening prior to the exercise. Here the goals and procedures of the exercise were explained to them carefully. Every attempt was made to

emphasize the fact that the primary goal of the exercise was to help the students get the most out of their education and appreciate its value.

At the beginning of the exercise each student received a booklet that contained a description of the scenario, a collection of reference and background data, and a number of specific questions and instructions. The scenario, which is described more fully in Appendix III, was based on the imagined grounding of a fuel barge in Long Island Sound. We selected this scenario because of recent well-publicized events that exemplified the kind of situation the cadets could expect to be involved in as Coast Guard officers. Although the object of the exercise was not to teach the cadets how to deal with an oil spill, we wanted the lessons learned to be placed as firmly as possible in the context of their future careers.

The cadets were required to make a series of decisions or recommendations based on the events as described in the scenario. Some of the problems required the direct application of discrete information or skills from the sciences or mathematics. Others were more interdisciplinary in nature and encouraged the participants to draw upon a broader range of knowledge and analysis. For example, the cadets were tasked with deciding which of three threatened shoreline areas should be protected from the expected oil slick, given that the resources available were adequate to cover only one. In order to make this decision, the participants had to first use information such as the quantity of oil spilled, wind speed and direction, and water currents to predict the most likely rate and direction of oil slick movement. Then they had to weigh the relative values of the three areas, the cost of cleanup, and the political and public relations consequences of making the wrong decision. Another interesting and challenging assignment was to draft a response to a letter supposedly written by a local university professor, criticizing the Coast

Guard's response to the crisis and questioning the adequacy of their preparedness.

After approximately two hours of individual work, the students were given the opportunity to reevaluate some of their decisions in a group setting. They were taken to a separate location in groups of five or six and instructed to sit down as a team to assess the situation and make a collective decision to protect one of the three shoreline areas threatened by the oil spill (one was a recreational swimming and boating area, one was a commercial fishing ground, and one was a wildlife preserve). As indicated above, they had already wrestled with this problem individually. Each group was given 20 minutes to arrive at a decision, and the ensuing discussions were videotaped. At the end of the group session, the participants were told to return to the common room to continue their individual work.

Later in the day, each cadet was advised to prepare a 5-minute situation report to be presented orally to his/her commanding officer, who was expected to arrive at the scene momentarily. After a 15-minute preparation period, the cadets were taken individually to classrooms where they presented their briefings to faculty members posing as the commanding officer. Each of these presentations was videotaped for subsequent assessment. In order to retain as much continuity as possible, we provided box lunches so the cadets would not have to return to the residence hall for the noonday formation and meal. They were encouraged to share their reactions and insights with the faculty monitors during the lunch break.

The final exercise activity was a debriefing period in which the participants were broken into groups of 8-10 and directed to individual classrooms. Here they were debriefed by faculty members who had been trained by the project's assessment director. A number of the questions asked

by the moderators were common to all groups, in an effort to collect a sufficient number of responses to draw some general conclusions. The specific issues discussed during these sessions, which were also videotaped, included asking the students to think about the value of their high school education, to comment on their reaction to the exercise, and to explore their expectations of what they were to learn in the coming four years. These sessions concluded the exercise.

Exercise Follow-up and Preliminary Assessment

The primary objective of the initial test exercise was to demonstrate the practical feasibility of the concept and to test the receptivity of the cadets. At the same time, however, we were mindful of our long-range plan that the exercise should serve as an important vehicle for assessing the effectiveness of a wide range of learning experiences at the Academy. Accordingly, we attempted to collect as much valid data as possible in the hope that it might prove useful in future assessment efforts.

Review of the written responses of the cadets, the videotape records, and the debriefing sessions led us to the following general conclusions and observations:

a. The cadets reacted very enthusiastically to the experience. They found it to be sufficiently realistic to capture their interest, and they reported that it enhanced their appreciation of the importance of education and its relevance to their future careers.

b. The logistics of conducting an exercise of this kind, though complex, were not impossible to overcome. Careful planning and design should make

it possible to expand the scope of the experience and increase the number of participants.

c. Although it was not among our initial goals, the most gratifying outcome of the exercise was its effect on the faculty members who participated as monitors. Several of them commented that the experience had given them new insights into ways to improve the coupling between teaching and learning in their individual courses. Some were surprised to observe a level of student enthusiasm that was noticeably lacking in their classrooms.

d. The booklet form of the exercise scenario permitted the cadets to skip around as if they were taking a normal course examination. Although some of the decisions required them to use the results of earlier analyses, the sense of the chronological development of events and the consequences of previous decisions was largely lost.

e. There appear to be no existing assessment instruments that can reliably measure the attitudinal value changes we hope to bring about. Therefore, we must develop and validate assessment methods that are appropriate to our particular goals and environment.

Perhaps the most immediate application of lessons learned in the scenario exercise was an innovation introduced by one of the authors (KAR), who happened to be the course coordinator for general chemistry. The normal classroom routine was suspended during the first full week of classes, and all sections were assembled for an evening session designed to establish clear links between chemistry and cadet visions of their futures. Organized as a sort of mini-version of the scenario exercise, this program was designed to enhance understanding of the relevance of chemistry in the Coast Guard

environment and to create an expectation of personal empowerment through the mastery of course concepts.

Early in the Fall semester, a committee of volunteers from several academic and professional development departments was formed for the purpose of planning the second exercise to be conducted in the Spring of 1992. In addition to developing the scenario and planning the exercise structure, the committee appointed several subcommittees to develop criteria for assessing the achievement of our desired outcomes. This sub-project was a natural consequence of the frustrations experienced by faculty monitors who had attempted to make baseline assessments of freshman competencies without the benefit of such criteria.

The Second Exercise

The second exercise was conducted in late April 1992, at the end of the Spring final examination period. The participants were 49 of the 57 survivors of the group of 65 who took part in the original exercise. This time the scenario was based on a hypothetical situation resulting from the collision of a ferry boat with a nuclear submarine at the mouth of the Thames River. Since our cadets frequently observe submarines moving to or from the Navy base just up the river from the Academy and ferry traffic in New London harbor is rather heavy, the cadets readily accepted the credibility of the scenario. The kinds of decisions required were similar to those presented in the August exercise, except that several were deliberately designed to require the integration and application of concepts and information learned during the academic year the cadets had just completed. Writing, speaking, and quantitative problem-solving assignments were again included.

The major change from August to April was the abandonment of the test booklet approach which had made it impossible to convey the sense of chronology and cause-and-effect associated with a real-life situation. In its place, we used a computer program that was designed to run on the cadets' own Apple Macintosh computers (all of our students are required to purchase approved personal computers at the beginning of the freshman year). The computers were packaged by the cadets the night before the exercise and transported for them to the exercise classroom the next morning. The program was then loaded into each machine just prior to the beginning of the exercise. It was designed to disable all competing functions of the computers so the cadets would be limited to the conduct of the exercise.

The new approach offered several advantages over the test booklet version. It was based on Apple's HyperCard application software, which makes it very easy to create a chronological flow of events that depends upon the decisions made by the participants. The resulting program (called a "stack") made it possible to withhold new information from the participants until they had completed preliminary assignments. It also gave us the flexibility of tailoring the development of the scenario to the individual response patterns, so that each participant could see the result of his or her earlier decisions. Once the basic decision tree structure is developed, it can be easily adapted to new scenarios by simply revising the textual descriptions and specific data and questions. Finally, it is possible to structure the program so that a wide variety of data potentially useful for exercise assessment can be collected automatically.

Once again the cadets were required to prepare and deliver oral presentations, which were recorded on videotape. This time, however, we did not attempt to repeat the group decision process. At the conclusion of the

exercise, the program was removed from the cadet computers, together with the files that had been created automatically to collect their responses and record their decisions. This method was also used to save their writing samples and their comments on the effectiveness of the exercise. Debriefing sessions were conducted with two groups of approximately twenty-five students each, and the discussions were videotaped for subsequent analysis.

The exercise participants reacted very favorably to the computerized format. They felt it was much more realistic than the earlier test-booklet version, and they liked the added dimension of seeing some of the consequences of their decisions. The earlier format was akin to a "post-mortem" analysis of events already transpired, whereas the computer simulation created a much more credible impression of events unfolding in real time. The greatest practical advantage of the computer approach was that it greatly reduced the number of faculty monitors required to supervise the exercise, and it suggested new approaches to be used in future exercises.

Scaling Up to a Full Class

After reviewing the results of the two exercises administered to a sample of the Class of 1995 and validating the apparent advantages of the HyperCard computer program approach, we decided to recreate the August 1991 exercise with the entire Class of 1996 (294 cadets, of whom 282 actually participated). The basic computer program structure of the April 1992 exercise was retained, but it was adapted to an oil spill scenario very similar to that used a year earlier. In view of the somewhat lower level of sophistication of the new cadets (compared with those who had completed the first academic year), the decision tree was simplified and the number of alternate pathways was reduced accordingly. Several minor procedural modifications were

introduced in order to take advantage of lessons learned from the two previous exercises.

We believe the optimum time to administer the exercise to the freshman class is immediately prior to the beginning of Fall semester classes. At that point, however, the cadets had either just received their computers or were still awaiting delivery. To make sure all of the cadets had acquired their computers and had an opportunity to become somewhat familiar with their operation, the exercise was delayed until approximately two weeks after the beginning of classes. It was held on a Friday, and freshman classes were canceled for the day. All faculty members involved exclusively or primarily in freshman instruction were expected to participate in the exercise as monitors, and others were encouraged to take part when they were not in the classroom. Several non-teaching members of the professional staff participated on a voluntary basis. The exercise was conducted in the cadet residence hall to avoid the enormous logistical problem of transporting more than 280 personal computers to classrooms in other buildings.

On the evening prior to the exercise, the entire class was assembled for a briefing to prepare them for the experience. Once again, the purpose of this session was to remove any apprehension about the consequences of their responses and to make sure they knew what to expect. They were told exactly why the exercise was being conducted, how we intended to use the results, and what they should expect to get out of it. This time, however, the newness of the cadet computers introduced an additional dimension to the briefing agenda. The exercise director (WRG) took special pains to assure them that good performance would not require more than the most elementary computer skills. For those not yet comfortable with their new machines, he

suggested a simple practice protocol to introduce the operations needed for the exercise.

The exercise monitors were organized into eight teams, corresponding to the eight cadet companies. Each company contained approximately thirty-six 4/c (freshman) cadets. To begin the exercise, the team leader conducted a short briefing in the company dayroom. This session covered the day's schedule, plus specific instructions about procedures to be followed in case of difficulty. Before and during the briefing, faculty monitors circulated among the cadet rooms to load the exercise program stack onto each computer.

The cadets were directed to begin the exercise as soon as they returned to their rooms and the program stack was loaded onto their machines. Explicit instructions appeared on the screen when they accessed the stack, and the exercise was largely self-directing from that point. Written responses and decisions were automatically recorded by the master program and saved in files that were labeled with the student's name and could be downloaded easily at the conclusion of the exercise. When each cadet reached the point in the exercise when it was time to begin the group decision segment, the computer issued a prompt that directed them to the monitor team leader for assignment to a group. After each group reached its collective decision and reported the result to the team leader, the members were directed to return to their rooms and continue with the exercise.

Later in the sequence, the participants were advised by the master program to begin preparation of a 5-minute briefing to be presented to the Coast Guard Group Commander upon his/her arrival. This briefing was to consist of a description of the events, a summary of action taken by the cadet in his/her imagined role, and additional information and/or recommendations expected to be of importance to the Group Commander.

Several faculty monitors played the Group Commander role in order to avoid cadets standing in line waiting their turns. The monitor stand-ins were encouraged to react as the genuine Group Commander might be expected to do, including appropriate questioning. During and after the briefing, the monitor completed an assessment form that included evaluations of the content, organization, and delivery of the briefing. Most monitors shared their reactions and suggestions with the cadets immediately upon the conclusion of the briefing. Approximately 25% of the presentations were videotaped for future viewing as part of the overall assessment strategy. This sample size was determined by the amount of video equipment available.

During the lunch break, faculty monitors circulated among the cadet rooms and extracted their writing samples. These had been deposited automatically into easily retrievable files by the master program. They were quickly scanned by a team of writing instructors to select a few particularly good examples to be used in the wrap-up session at the close of the exercise. When the cadets returned from lunch, they were given a few minutes to complete the evaluation questionnaire that was the final part of the exercise program. Their responses were automatically saved along with the other data collected in the course of the exercise. After these files were removed to archival diskettes by the faculty monitors, the cadets were instructed to purge all of the exercise files from their individual computers.

At the conclusion of the exercise, the cadets were directed to assemble in an auditorium for the wrap-up session. As a result of cadet comments after the previous year's exercise, a faculty member with practical experience in oil spill response discussed the scenario and indicated the likely actions that would have been taken by actual Coast Guard personnel. An English instructor displayed an especially good writing sample and discussed the

elements that made it effective. Finally, the cadets were encouraged to share their reactions and suggestions in an informal but directed feedback session conducted by the project's director of assessment. The comments and questions that came out of this session were also recorded for later review and analysis.

Assessment and Future Plans

Although the primary goal of the first three exercises was to demonstrate the feasibility of the concept and to work out logistical details, preliminary designs of the assessment plan and long-range follow-up strategy were initiated at the same time. A substantial amount of objective and subjective data was collected, and several assessment concepts were tested. In a subsequent paper we will report in detail on the conclusions drawn from these preliminary assessment activities. We will also describe our long-range plans for evaluating the impact of the exercise experience and using the results to improve the teaching and learning process at the Coast Guard Academy.

We plan to repeat the exercise with the entire freshman class at the end of the 1992-93 academic year. There will also be limited participation by sophomores experiencing the same scenario, but in more responsible roles. These participants will be chosen from the original exercise and control groups. We will add a new class each year until the entire student body is participating in the exercise. At this point it is our intent to use the same basic scenario idea for all classes participating in a given year. The class levels will be differentiated by the amount and kind of information provided and the responses expected. This approach may require less effort than designing four independent scenarios each year. Moreover, it is quite possible that we will evolve toward the concept of a single exercise that involves teams of

participants drawn from all four classes with specific roles assigned by year group. The extra ingredient of interactions among cadets with different levels of sophistication and responsibility could add significantly to the realism and effectiveness of the experience. It should also contribute to the sense of increasing empowerment as the cadets progress through the academic and professional development programs.

In conclusion, we believe this exercise concept is beneficial to both students and faculty. From the institutional standpoint, it gives us an opportunity to assess the achievement of some of our more general educational objectives in contexts that are difficult to reproduce in the environment of traditional academic courses. It is a way to increase motivation and counter the common tendency for college students to discount learning activities they view as unrelated to their future ambitions. Most of the students feel that it helps them place their academic studies in perspective and provides a common framework for the integration of knowledge from a variety of disciplines. We hope it will also create a sense of increasing empowerment that will encourage the students to become life-long learners.

Applicability to Other Institutions

The Coast Guard Academy enjoys a number of rather obvious advantages in conducting exercises like those described in this paper. Among these are small size (just under 1000 students), universal ownership of compatible personal computers, and an atypical degree of control over student activities. Furthermore, every student goes to the same kind of job immediately after graduation. We recognize that few colleges or universities could duplicate our experience with their entire student body. However, we believe the concept is quite applicable to appropriate subsets of the student population at

any institution. It is only necessary that there be some overlapping of the student participants' visions of their futures. Perhaps they could be the population of a particular academic major, or those who intend to pursue careers in business, or those interested in public service. The faculty, for its part, must have developed a shared set of common objectives or outcomes of the overall educational experience. They must believe truly in the concept of interdisciplinary learning, and they must be willing to dedicate a significant amount of time and energy over and above their normal duties in order to make the experience work. The payoff, however, is an exhilarating blend of excitement and insight.

References

Following is a list of some of the sources we found to be most helpful in designing our exercises and using the scenarios to create contexts for educational objectives:

Bosselmann, Peter, "Dynamic simulation of urban environments: twenty years of environmental simulation at Berkeley," *Institute of Urban and Regional Development*, Vol. 25, University of California at Berkeley, 1990.

Conner, David A., "Metro-Apex: A Contrived Experience," *Engineering Education*, Vol. 64, No. 2, pp. 127-129, November 1973.

Coombs, Don H., "Games? They're a Serious Approach to Learning. Educational Technology Revisited: Profile 11," *Planning for Higher Education*, Vol. 4, No. 5, pp. 23-28, October 1975.

Hatcher, Joe W., Jr., "Using Riddles to Introduce the Process and Experience of Scientific Thinking," *Teaching of Psychology*, Vol. 17, No. 2, pp. 123-24, April 1990.

Holgate, Alan, "Role-play Simulation of Building Design Projects," *European Journal of Engineering Education*, Vol. 12, No. 3, pp. 277-83, 1987.

Kardos, G., "Pointers on Using Engineering Cases in Class," *Engineering Education*, Vol. 68, No. 4, pp. 347-9, January 1978.

Ladousse, Gillian Porter, *Role play*, Resource books for teachers Series, Oxford University Press, New York, 1987.

Lambert, Lisa A., "Disease detective: a game simulation of a food poisoning investigation," *American Biology Teacher*, Vol. 51, No. 7, pp. 429-32, October 1989.

Marshall, Stewart, "Communication Studies and the Extended Power Station Game," *Physics Education*, Vol. 16, No. 6, pp. 347-51, November 1981.

Marshall, Stewart *et al.*, "Developing Communication Skills Using Simulation/Gaming Techniques," *Simulation/Games for Learning*, Vol. 12, No. 2, pp. 61-69, Summer 1982.

Prohaska, Charles R. and Frank, Ellen J., "Using Simulations to Investigate Management Decision Making," *Simulation and Games*, Vol. 1, No. 1, pp. 48-58, March 1990.

Scott, Andrew M., "Designing a Societal Simulation," *Academic Computing*, Vol. 2, No. 6, pp. 6-10, 43, March-April 1988.

Sculli, Dominic, "Using Business Games in Engineering Courses," *Engineering Education*, Vol. 75, No. 3, pp. 159-61, December 1984.

Smith, Peter, *Instructional simulation: research, theory, and a case study*, U. S. Dept. of Education Office of Educational Research and Improvement (OERI), Washington, D. C., 1986.

Stevens, John D. and Ulrichson, Dean L., "Computer Simulation Games," *Engineering Education*, Vol. 64, No. 2, pp. 124-126, 158, November 1973.

Stoddard, Mary Lawrence, *Learning styles and embedded training: a case study*, Los Alamos National Laboratory, Los Alamos, New Mexico, 1985.

Sulock, Joseph M., "The Free Rider and Voter Paradox Games," *Journal of Economic Education*, Vol. 21, No. 1, pp. 65-69, Winter 1990, Report No. ISSN-0022-0485.

26

Appendix I

The Core Curriculum
at the
United States Coast Guard Academy

Introduction to Engineering Design
Foundations of Computer Science
Organizational Behavior
Calculus I & II
Chemistry I & II
English Composition and Speech
Introduction to Literature
History of the U. S.
Physics I & II
Economics
Probability and Statistics
American Government
Morals and Ethics
Oceanography
Introduction to Electrical Engineering
Legal Systems
Basic Naval Architecture
Maritime Law Enforcement
Nautical Science I to IV

27

Appendix II

United States Coast Guard Academy
ACADEMIC DIVISION
Desired Outcomes

The acquisition of a specific body of knowledge and mastery of a prescribed set of concepts are only a part of the undergraduate educational experience. Indeed, a more important long-range purpose is to lay the foundations for self-evaluation and life-long learning. Many of the skills and insights that should be acquired in the course of a good undergraduate education are spread across broad segments of the curriculum and cannot be associated with specific courses. Moreover, a number of the generally accepted goals are not identified explicitly in the syllabus of any course.

If the Faculty is to design curricula and courses that go beyond the simple transmission of knowledge and truly contribute to the intellectual and ethical development of the cadets, there must be a plan which defines the desired outcomes of the educational process in terms of the attributes and abilities our graduates must possess as future leaders of the Coast Guard. The plan must be in a form which can provide effective guidance for the design of courses and curricula, for the conduct of classes and laboratories, and for the measurement of educational effectiveness.

This set of Outcomes cf the Academic Division is intended as a dynamic document, and it is expected that it will evolve as our experience accumulates and as our understanding of the educational process deepens. Just as the assessment of instructional effectiveness is a continual process that begins the day a cadet enters the front gate, so the evaluation of the outcomes and their achievement must be a conscious and regular exercise. The success of any self-corrective system depends upon frequent measurement and prompt feedback.

USCGA graduates should be able to:

1. Apply the basic skills of critical analysis, quantitative reasoning, and problem-solving to complex tasks in a broad range of contexts.

   Discussion: The techniques and habits of quantitative problem-solving learned or reinforced in technical courses are applicable to a much broader range of practical problems. It is essential that cadets be given opportunities to practice these skills in new situations outside the scope of textbook examples. Identifying variables, evaluating both quantitative

and qualitative data, selecting or designing models, and justifying assumptions are examples of transferable aspects of problem-solving.

Implementation: Senior projects provide one proven mechanism for giving students the opportunity to apply their skills to problems that are unstructured and open-ended. At every level, however, imaginative exercises can be designed to push beyond the textbook scenario and introduce elements of ambiguity, incomplete data, and other characteristics of real-world problems. Furthermore, cadets taking courses in the humanities or social sciences might be required to produce position papers in which they must deal not only with subjective or qualitative issues, but also must analyze and interpret quantifiable variables that are relevant to the basic thesis.

2. **Integrate new ideas and information efficiently into a working conceptual framework that lends itself to continued expansion and refinement.**

Discussion: Admittedly this outcome is not easy to grasp, and its implementation is a genuine challenge for the inexperienced instructor. Translated into the simplest terms, it means the cadets should be helped to "see the big picture." Different fields of study often share similar models and frameworks of knowledge. For example, the intellectual process of reconstructing historical events has much in common with the investigation of experimental phenomena in physical science. Learning new subjects is much less difficult if the students can relate the new concepts and material to the mental foundations they have already constructed to support and organize the knowledge they have previously acquired. Furthermore, developing the habits of consciously seeking common patterns and analogies helps students become more sensitive to their own patterns of intellectual development. They should be given the opportunity to explore new horizons, beginning with obvious extensions of what they have already mastered and continuing outward in ever-broadening circles. It is clear that the effective development of this outcome requires both mutual understanding and cooperation between faculty members in different disciplines.

Implementation: One of the criticisms we share with other military academies is that our highly structured program allows little opportunity for students to reflect on the things they have learned. In the rush to cover all of the required material, they are hurried from one assignment to the next in a sometimes frantic pace. Furthermore, junior instructors charged with covering an assigned syllabus are equally susceptible to the pressure to race through the material. Given this institutional environment, it is all the more essential that instructors make conscious efforts to pause at appropriate times for the purpose of making connections and helping the cadets relate what they have just learned to

their previous framework of knowledge. Likewise, they need to be challenged to think about extensions of new concepts into areas beyond the boundaries of the present topic. In every upper division course, cadets should be given projects or assignments that require them to extend the boundaries of the conceptual frameworks they have used in the basic classroom material. Properly designed projects may not only show the students how their frameworks can be applied to new subject areas, but also reinforce their understanding of the fundamental models and their confidence in applying them to traditional problems. A classical example in this respect is the insight one gains into the structure and subtleties of English through the study of a foreign language.

3. **Prepare and deliver well-organized and polished oral presentations to a variety of audiences on any topic within their fields of competence.**

Discussion: This outcome is one of the most easily defended, since all Coast Guard officers can expect to be thrust time and time again into situations where success depends heavily upon effective oral communication skills. Scenarios range from passing the word to an assembled division, through addressing a local civic group or briefing a group of senior officers, to presenting a technical or professional paper to an audience of experts. The Academy experience should take every opportunity to get cadets on their feet in front of a variety of audiences on a range of topics so they can learn to be comfortable in any setting.

Implementation: It is suggested that every instructor consider incorporating some kind of oral presentation into the classroom format. Some formal preparation should be required and there should be not only evaluation, but also a positive feedback system. In addition, group discussions involving informal exchange of ideas help develop the ability to think under pressure and contribute to team efforts.

4. **Write clear, concise, persuasive, and grammatically correct passages on general or professional topics, from a paragraph to several pages in length.**

Discussion: The use of writing in the general curriculum not only develops skills that are of basic value in all aspects of officer performance, but also serves to aid and reinforce the learning process. There is ample research to support the contribution of writing to understanding and retention, even in technical subjects.

Implementation: Every course at the Academy should involve writing in some way. In quantitative fields it is often very useful to verbalize, both orally and in writing, concepts that are learned in the form of abstract

symbols and equations. As with the speaking process, every writing exercise should be evaluated and criticized to ensure that abilities are encouraged to develop continuously.

5. **Plan and coordinate a wide variety of operations, making effective use of resources and adapting to the policies, organizational structure, and decision systems of the Coast Guard.**

   Discussion: Planning operations is one of the most universal intellectual activities commissioned officers can expect to be engaged in on a regular basis. Even routine repair, maintenance, or training operations of the type likely to be entrusted to ensigns can involve careful coordination of personnel and material resources in situations where realities may appear to contradict prescribed policy guidance. Graduates must understand this interplay and the need for finding suitable compromises between conflicting demands and pressures. They must develop the confidence to deal responsibly with the tensions that inevitably surround real-world operations. At all ranks they will be required to work within established organizational structures. They can do so most effectively if they understand thoroughly the functional logic and purpose of the management and decision system.

   Implementation: Much of the project work cadets engage in both in class and in academic extracurricular activities can legitimately be characterized as Coast Guard operations requiring planning. Instructors and club advisors can contribute to the development of planning skills by encouraging cadets to be conscious of the process and making sure they are not denied opportunities to learn by making mistakes in the allocation of resources. Many courses in the curriculum relate to operational or administrative functions of Coast Guard units and organizations. Instructors should take every opportunity to identify these components and discuss briefly their position and function within the overall organization. In some courses it may be appropriate to ask cadets to criticize existing structures or devise workable alternatives. The Coast Guard's current emphasis on Total Quality Management offers an appropriate motivation for encouraging cadets to think about the rationale for organizations and procedures.

6. **Function effectively as a member of a team or working group that is charged with studying a complex problem or a significant policy issue and arriving at a solution or recommendation.**

   Discussion: Before important policy decisions are made, it is common practice to convene study groups to collect and evaluate information, examine alternatives, and make recommendations supported by data and

reasoned arguments. Coast Guard officers can expect to serve as members or leaders of such groups at all stages of their careers. To be seen as a valuable contributor or catalyst in such situations is a strong factor in enhancing an officer's career and increasing the probability of being picked for desirable assignments in the future.

Implementation: There are few academic courses that do not offer opportunities for group study or group projects. In creating or encouraging such groups, instructors must give careful thought to the importance of evaluating individual performance and providing feedback to help cadets assess and improve their own contributions to the team.

7. Show evidence that they are capable of honest, realistic, and constructive self-evaluation, that they can devise successful and creative strategies to develop their strengths and correct their weaknesses, and that they possess the intellectual, moral, and physical stamina to follow through.

Discussion: Although the Coast Guard's OER system is designed to identify the strengths and weaknesses of officers and provide corrective feedback, the most effective professional growth comes through self-assessment, self-motivation, and self-regulation. Cadets must be encouraged to develop habits of continuing objective examination of their own performance and must be assisted in reaching a level of experience and confidence that validates their judgments.

Implementation: Instructors and academic advisors can contribute effectively to the development of self-evaluation skills by insisting that cadets go through the exercise of evaluating their own performance before it is graded externally. Every teacher who has taught a subject involving specific performance goals has had to respond to the question "How do I know when I'm doing it right?" (with "when the answers are not in the book" as the unspoken completion of the question) One of the specific course objectives should be to enable students to answer this question for themselves.

8. Articulate their personal values and those of the Coast Guard and public service in general, recognize conflicts in value systems when they exist, and formulate reasoned arguments to support their resolutions of the conflicts.

Discussion: Every cadet arrives at the Academy equipped with a system of personal values. Some may find it difficult to define and articulate their own values without guidance. All, however, must learn to function

within the Coast Guard's value system and must reach their own accommodation with the conflicts that are likely to arise.

Implementation: Instructors should be alert to point out problems and issues whose solutions are influenced by considerations of personal or institutional values. Cadets should be encouraged to examine these situations and identify the areas of potential value conflicts. They should then be invited to explore personal strategies for removing the conflicts.

9. Comprehend the diversity and interplay of economic, technological, political, social, climatic, and cultural forces that shape the local and global environments in which the Coast Guard operates.

Discussion: The Coast Guard is unique among the military services in the extent to which it interacts directly with the general public in the normal prosecution of its mission. Often the commanding officers of small units or stations are the primary representatives of the federal government in the local community. In order to function effectively, these individuals must have a good understanding of the values, motivations, and politics of the groups who look to them for leadership or with whom they must cooperate.

Implementation: This outcome is one of the fundamental justifications of the general education component of the academic curriculum. One feasible approach is to introduce the concept of systems at an early stage, helping the cadets identify the individual components they must explore in some depth in order to understand the dynamics of the community as an example of a system.

10. Gain access to a broad range of information systems and locate desired data reliably; make effective use of modern decision support systems.

Discussion: For officers attending graduate school or assigned to technical or policy staff positions, it is absolutely essential that they be able to access information sources. Furthermore, the explosion of information and the growing diversity of storage and dissemination media demands that managers at every level become adept at locating, recovering, and interpreting data in an increasingly complex environment.

Implementation: Every course director should consider including an appropriate library/information system exercise designed specifically to build on the introductory lectures and demonstrations presented to cadets during their first year. These exercises should increase in scope and difficulty throughout the 4-year program, so that graduates are able to

function effectively in a multi-media research and information environment. In addition, all cadets should be introduced to such modern decision aids.as spread sheets, database management systems, PERT charting, etc., in a broad range of contexts. Exercises using these tools should be carefully designed to convey an appreciation of both their value and their limitations.

11. **Read and understand a variety of written materials, listen critically to oral arguments, and formulate penetrating questions.**

Discussion: Coast Guard officers are frequently required to digest large volumes of information, identify the critical data or arguments, and prepare concise summaries of the key issues addressed. In order to do so successfully in a wide range of circumstances, they must have well-developed reading and listening skills. They must be able to ask appropriate and probing questions, and to evaluate the accuracy and relevance of the answers. Examples of junior officer tasks that depend on these skills are counseling enlisted persons and serving as investigating officers.

Implementation: Cadets should be required to prepare executive summaries of assigned readings and special lectures, for example, as a mechanism for honing their reading and listening skills. They should also be urged to develop the habit of testing themselves by writing down the important points of any reading or listening experience. Slow readers should be encouraged early in their cadet careers to take advantage of available programs for improving reading speed and comprehension. Interview skills might be cultivated by occasionally deviating from the lecture or recitation formats and letting the students acquire information in the classroom by interviewing the instructor.

Appendix III

AUGUST 1991 EXERCISE SCENARIO

The following exercise scenario will allow you to participate in a simulated pollution event similar to the type of operation that you might encounter during your future Coast Guard career. For this exercise assume that you are a Coast Guard Lieutenant and serving as the Operations Officer of Coast Guard Group Long Island Sound, New Haven, Connecticut. Your duties include coordinating the Coast Guard's response to search and rescue cases and pollution incidents in the Long Island Sound area. You have the following materials and information available to assist you:

   Section of the nautical chart of Eastern Long Island Sound (12354)

   List of Coast Guard and other response resources

   Mini-library of reference books (Dictionary, Thesaurus, CRC Handbook of Chemistry & Physics)

   Your hand-held calculator

At 0900, 17 August 1991, the tug boat MOBILE ONE reports that its tow, a 200 foot tank barge (MEKNISEW #134), carrying 100,000 gallons of #4 heating oil, has broken free and drifted aground on the south end of Falkner Island, in Long Island Sound at position 41-12.6 N, 72-39.3 W (approximately 13 nautical miles east-southeast of New Haven, CT). One of the barge's ten 10,000 gallon tanks is open to the sea with all oil spilled. Two other 10,000 gallon tanks are damaged and leaking at a combined rate of 500 gal/hour. The remaining seven tanks are intact. There is also a 100 lb propane cylinder on the deck of the barge. The cylinder has been reported to have broken free from its mountings and may be damaged.

The on scene weather: wind from the south at 20 knots; seas from the south, at 1-2 feet; air temp 85 °F; water temp 70 °F; visibility is 1-3 miles in patchy fog. Under these conditions, oil will spread directly downwind at about 3% of the wind speed. Tidal currents in the area are strong and will also affect how the slick moves. During the flood (incoming) tide the current averages 1.1 knots toward the west. During the ebb (outgoing) tide the current averages 1.0 knots toward the east. The tide has been ebbing since 0730 and will continue to ebb at the 1.0 knot average for the next four hours. It will then diminish and start to flood at 1330. The weather is forecast to remain essentially the same for the next 12 hours with winds becoming light and variable after dark.

There are two persons aboard the MOBILE ONE. The tug has good communications with the barge via VHF-FM radio but cannot reach the barge due to shallow water. Four persons were on the barge getting ready for arrival

in port when it broke free; all speak Spanish only. They do not have survival suits. One of them is a non-swimmer.

The owner of the MOBILE ONE and the MEKNISEW #134 is Marion Mobile Enterprises, a minority-owned small business at 232 West Street, New Haven, CT. Phone: (203) 454-8767. Marion Mobile was recently the subject of a highly acclaimed TV documentary because it is a very successful minority business. The owner of the oil is Mobile Oil, International. The nearest corporate office is 5445 Madison Ave, New York, NY. Phone: (212) 665-9812.

Marion Mobile is assuming responsibility for the clean-up efforts. Marion Mobile has a $2,000,000 pollution insurance policy. They have asked you, as the federal On Scene Coordinator (OSC), to meet with them to determine the extent of the problem and to work with them in approving a cleanup strategy, including identifying what resources are needed to clean up the spill.

Several environmentally sensitive areas are nearby. Hammonassett State Park and Beach is 5 nautical miles to the northeast. A marine sanctuary for rare sea birds is located in The Thimbles, approximately 5 nautical miles to the northwest. The marsh area in Guilford (including the West River and the East River), a prime shellfishing and boating area, is approximately 3 nautical miles to the north. The north coast of Long Island lies about 13 nautical miles south of Falkner Island and includes numerous public beaches and wildlife refuges.

Both the Sierra Club and Greenpeace have advised you that catastrophic environmental damage will occur if the oil reaches The Thimbles Wildlife Refuge.

The Connecticut Department of Parks & Recreation has told you that environmental damage will be severe and the economic impact devastating to Connecticut if the oil reaches Hammonassett State Park and Beach.

The New Haven fishermen's association is up in arms because the spill threatens their fishing grounds. They will provide up to six fishing boats to help, but want action now.

Newspaper & television press groups from New Haven, Hartford, and New York City are following the incident closely. Due to the proximity to New York, both the Associated Press and UPI wire services are also interested.