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**TRAINING IMPLICATIONS OF SKILLS NEEDED
FOR ENVIRONMENTAL CLEANUP***

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ABSTRACT

Well-trained staff are needed to perform the diverse tasks associated with environmental cleanup. Although educational and training programs are intended to help professionals learn relevant environmental skills, these programs may or may not be teaching the most appropriate skills. This project investigated the skills needed to carry out environmental activities at a headquarters office of a federal agency. The primary skills needed for environmental cleanup activities emphasize program management, problem solving/critical thinking, and communications. Furthermore, using Bloom's taxonomy of educational objectives, most of these skills fell into the areas of "application" or "evaluation." The results of this investigation suggest that rather than focusing on discipline-specific activities, such as helping improve people's knowledge about regulatory requirements, training and education should emphasize complex problem-solving skills.

INTRODUCTION

Well-trained and highly skilled staff are needed to carry out the complex activities associated with environmental restoration and management. In addition to contributing to a smoothly functioning organization, if staff are well trained, they are usually more satisfied

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with their work and are likely to stay longer at their jobs (Hubble and Green 1992; Kleiman 1993). The purpose of this project was to determine the relevant focus of training and education for environmental professionals at a federal agency by identifying the skills they need to carry out their work.

METHODS

An inventory of possibly relevant knowledge, skills, and abilities (hereafter referred to as "skills") was collected from position descriptions, training oversight organizations (Close 1987; Meshenberg et al. 1992), and literature on environmental training, problem solving, and decision making (Green et al. 1985; Segal et al. 1985; Posner 1989). These skills fell into several content areas: administration, biology, communications, engineering, environmental laws and regulations, hazardous wastes and materials (management), organizational structure, physical sciences, safety and health, and supervision. The result of this inventory was a list of 78 skills.

The 78 skills were compiled into a data collection workbook, and staff from the headquarters office of a federal agency then specified how critical each skill is for performing a task under ideal conditions. Next, responses were tabulated to determine the most critical skills for each task, and the most critical skills were then tallied across the universe of tasks (that staff might perform) to determine the critical skills needed for most tasks.* These critical skills were examined for thematic groupings. Finally, to consider how best to gear training and educational programs, the skills were analyzed according to Bloom's six-level taxonomy of educational objectives for the cognitive domain: knowledge, comprehension,

*The results may be limited by the small sample or by uncertainty regarding whether the list of skills is comprehensive.

application, analysis, synthesis, and evaluation (Bloom 1956). The definitions for the six levels of Bloom's taxonomy for the cognitive domain are summarized as follows:

- Knowledge: remembering previously learned information;
- Comprehension: grasping the meaning of material;
- Application: using learned material in new situations;
- Analysis: breaking down material into its component parts;
- Synthesis: putting parts together to form new whole; and
- Evaluation: judging material based on definite criteria.

RESULTS

Twenty-three of the 78 skills listed were considered critical for the majority of tasks and fell into the three general categories: critical thinking and problem solving, communications, and program management (Table 1). Problem-solving skills included "keeping abreast of current developments," "organizing/categorizing," "anticipating unintended consequences," and "examining trade-offs among alternatives." Examples of communication skills were "providing clear guidance and direction to accomplish tasks" and "writing clearly and succinctly." Program management skills included knowledge of the mission, policy, and goals of the organization and the ability to "identify relevant materials and requirements."

Although these three major categories are helpful for suggesting the areas that educational programs should address, more detail is useful to fine-tune pertinent training and education. Therefore, skills needed for at least half the universe of activities/tasks were further classified in terms of Bloom's taxonomy of objectives for the cognitive domain (Bloom 1956). The results, which are presented in Tables 1 and 2, indicate that most of the

skills needed by staff to carry out their tasks are more complex or "higher order" skills, such as application and evaluation. Nearly 20% (n=4) of the skills fell under the "knowledge" level, but only one skill fell into the "comprehension" level. Indeed, over 20% of skills fell into the "application" level, and 30% were considered "evaluation" skills. Even though many of our training programs are narrowly focused and geared toward knowledge and comprehension levels (Government Institutes, undated; U.S. Department of Energy 1994, undated; Kleiman 1995), these findings suggest that training and educational programs should focus on the more complex skill levels.

SUMMARY AND IMPLICATIONS FOR TRAINING

Skills needed for environmental tasks are mostly generic skills rather than discipline-specific skills. These skills fall into the general categories of problem solving/critical thinking, communications, and program management. Furthermore, by using Bloom's (1956) taxonomy, we found that many of these skills are "higher order" cognitive skills such as analysis and synthesis. Yet typically we train for lower levels such as knowledge and comprehension. These findings suggest that training programs may need a different emphasis. Many strategies have been identified for solving problems in diverse environments (MacCrimmon and Taylor 1976). The findings from this project suggest that teaching these strategies would be appropriate for personnel involved with the complex environmental tasks that they perform at headquarters offices of federal agencies.

TABLE 1 Skills Needed to Perform Tasks Associated with Environmental Cleanup

Skill	Number of Tasks in which Skill is Critical	General Skill Category	Category in Bloom's Taxonomy
Agency's mission, policies, management plans, procedures, priorities, goals and objectives	50 ^a	Program management	Knowledge
Keeping abreast of current development	47	Critical thinking	Evaluation
Identifying relevant materials/requirements	47	Critical thinking	Evaluation
Writing succinctly and clearly	45	Communications	Synthesis
Defining applicable criteria	45	Critical thinking	Application
Anticipating unintended consequences	43	Critical thinking	Application
Organizing/categorizing	42	Critical thinking	Application
Examining trade-offs among alternatives	41	Critical thinking	Evaluation
Providing clear guidance and direction to accomplish tasks	40	Communications	Application
Defining boundaries of a problem	39	Critical thinking	Evaluation
Understanding schedule constraints	39	Program management	Knowledge
Comparing existing conditions to pre-set standards	38	Critical thinking	Evaluation
Organizing information and present cogent arguments	37	Critical thinking	Synthesis
Agency management strategies	37	Program management	Knowledge
Assessing strengths and weaknesses of alternatives	37	Critical thinking	Evaluation
Analyzing information	35	Critical thinking	Analysis
Prioritizing based on criteria	33	Critical thinking	Evaluation
Planning, programming, funding and acquisition management	30	Program management	Synthesis
Negotiating/conflict resolution	29	Critical thinking	Analysis

TABLE 1 (Cont.)

Skill	Number of Tasks in which Skill is Critical	General Skill Category	Category in Bloom's Taxonomy
RCRA/CERCLA process ^b	28	Critical thinking	Comprehension
Decision analysis	37	Critical thinking	Analysis
Facility, site, operation and processes	27	Program management	Knowledge
Project or program management techniques	27	Program management	Application

^a Based on universe of 52 tasks.

^b RCRA = Resource Conservation and Recovery Act; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.

**TABLE 2 Skills Related to Bloom's Taxonomy
of Objectives for the Cognitive Domain**

Level	Number of Skills	Percentage
Knowledge	4 ^a	17 ^b
Comprehension	1	4
Application	5	22
Analysis	3	13
Synthesis	3	13
Evaluation	7	30

^a See Table 1 for specific skill.

^b Numbers do not equal 100% due to rounding.

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