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Hazardous Waste Worker Education:

Long-Term Effects

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Abstract

This study illustrates how a union education center successfully integrated adult empowerment education principles into the teaching methods and curriculum of a health and safety training program. The 12-month follow-up phone survey involved 481 local union respondents each representing a separate plant site and a group of 50 manager trainees. The evaluation shows that the training manual continued to be used by more than 70% of respondents, more than 70% taught coworkers, more than 50% of union trainees went on to train their managers, and more than 90% identified problems at work and sought and obtained changes in programs, training, or equipment. More than 20% reported that major spills had occurred following training. The majority stated that the handling of the spills improved. More than 80% stated that the training better prepared them for their health and safety duties. The managers' data substantially supported union members' reports.

The International Chemical Workers Union (ICWU) received one of the first of 11 national awards in 1987 from the National Institutes of Environmental Health Sciences to provide training for hazardous waste and emergency response workers.

The Superfund Amendments and Reauthorization Act of 1986 mandated that the Occupational Safety and Health Administration develop a standard for training and regulation of health and safety conditions for workers at hazardous waste cleanup sites, at Resource Conservation and Recovery Act (RCRA)-regulated Treatment, Storage, and Disposal facilities, and at industrial plants where workers respond to substantial chemical releases.

In 1988, the ICWU established the ICWU Center for Worker Health and Safety Education in Cincinnati, Ohio with an empowerment education approach to training. [1] The Center is the

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cooperative effort of six industrial unions, a local occupational health center, and a university environmental health department. Although concerned about teaching workers to protect themselves in hazardous situations, the ICWU Center has broadly defined its mission as promoting worker abilities to solve problems and to develop union-based strategies for improving health and safety conditions at the work site.

Evaluation of such a broad mission necessitates long-term follow-up at the work site to determine workers' use of skills gained during the training, and their attempts and successes in obtaining changes in work site conditions. This comprehensive evaluation differs considerably from the typical evaluation design, which focuses on an immediate assessment of information retention and degree of satisfaction with the training program.[2,3] Since the late 1970s, most published studies that have evaluated changes at the work site have narrowly focused on assessing specific behaviors following performance-based training.[4-9]

More recently, evaluators of training programs have recognized the need to assess worker actions to improve conditions. Through these evaluations, several training components have been identified as important for promoting behavioral and work environment changes. These have included small group interactive methods, [10,11] equal union and management participation,[12-15] a union support structure,[16] worker-produced materials and evaluation measures,[17,18] program development based on assessing worker needs and workplace problems,[19] and worker empowerment goals.[1]

This article illustrates how, through its training philosophy, the ICWU has combined many of these components into its teaching methods and specific curriculum content. Evaluation outcomes show successful results in terms of effects on both program participants and workplace conditions.

Methods

The Training Program: Recruitment and Eligibility

Each year approximately 30 4- or 5-day chemical emergency/hazardous waste training programs are held at the ICWU Center in Cincinnati. These sessions are attended by members of the 6 participating industrial unions. Of those, roughly 10% are joint labor-management programs. Workers who respond to substantial releases of hazardous substances or who work with hazardous waste are eligible for training. To encourage participant follow-through on knowledge and skills gained during training, the Center recommends the following parameters to local unions: (1) that each site send 3 or 4 participants to a session (the Center believes a core of trained workers is more likely than an individual to persist in the struggle to improve health and safety conditions); (2) that local unions be encouraged send at least one union health and safety committee member (these members are likely to have a solid background in health and safety issues, knowledge of plant conditions, and experience dealing with the company to improve conditions); and (3) that a maximum of 24 students attend each class to promote discussion and allow for adequate instructor-to-participant ratios. Typically, 6 to 8 facilities are represented per session.

Program Goals

The Center training program has two interrelated goals. The *long-term goal* is for workers to become and remain active participants in determining and improving the health and safety conditions under which they work. The *immediate educational goal* is to provide students with relevant tools, problem-solving skills, and the confidence needed to use those tools. The program fulfills its long-term goal only when the immediate goal is met. To this end, the curriculum focuses on analyzing and solving problems. The program teaches workers where to look for answers as well as on how to use and interpret the information they discover. For example, participants are taught how to search reference materials for needed information and problem solving.

Curriculum Methods and Content

The Center's training is designed to be worker centered and nonthreatening, and to encourage the active participation of all students. Many participants are uncomfortable in formal educational settings and a limited number have poor literacy skills. Even the few lecture sessions are informal and highly interactive.

Approximately 60% of the program occurs in the classroom and involves small group research, problem-solving exercises, evaluation of in-plant conditions, interactive videos, skits, and general discussion. Hands-on training, which includes the use of personal protective equipment, drum handling, and plugging and patching techniques occupies the remaining 40% of the program. The program concludes with a full dress-out chemical spill response simulation with actual leaking drums, valves, and pipes.

The instructional methodology is based on a participatory empowerment approach now used extensively throughout the United States. Many emergency response and hazardous waste worker training consortia,[18,20,21] right-to-know training programs,[10,14,22] and other labor education training programs.[16,23-30] have adopted this philosophy.

Partially based on the educational ideas of Brazilian educator Paulo Freire, empowerment education recognizes the importance of a partnership between the worker-participants and the trainer.[27] Trainers act as resources rather than as experts. The curriculum deliberately invites worker experiences and knowledge into the classroom, presents authentic situations for discussion, and develops strategies for critical thinking and social action. Participatory exercises provide opportunities for hands-on interaction and simulation of real hazards. They also enable workers to engage in genuine dialogue about the barriers to work site changes and what workers can do individually and as a group when they return to their work site. The specifics of how this philosophy translates into the curriculum are presented in the Appendix.

Achieving Long-Term Goals

The Center conducts anonymous pretraining and posttraining knowledge tests as part of each program to document an increased level of knowledge. However, a more important measure of program effectiveness is its impact upon the sustained workplace involvement of returning trainees.

To facilitate long-term student participation in improving conditions, the curriculum involves students in developing their own evaluation tool called a Risk Chart. Near the end of each training session, students from the same site work together using the Risk Charts to assess the strengths and weaknesses of their company's various programs. The Risk Chart is a highly visual score card that enables students to give a grade for a range of issues under the headings of (1) emergency response preparedness, (2) hazard communication and awareness, and (3) protective clothing and equipment programs. Typically, each issue includes a training and a program component. Risk Charts are divided into boxes that are each labeled with a different aspect of the plant's health and safety practices, policies, training programs, engineering controls, or equipment. In each box, local union members place a green mark if the plant operates safely in that area. Students use a red mark if the company needs to improve current practices. During joint labor-management programs, company and union representatives complete the charts together. The following are examples of Risk Chart box headings: "the hazardous chemical containers are clearly and correctly labeled," "MSDSs [material safety data sheets] are accessible to all workers," and "the Emergency Response Team has monthly drills."

This evaluation process aids students in synthesizing classroom and hands-on training with their real world experiences. Completed Risk Charts present an immediate visual image of the general degree of risk associated with a facility. Using the completed charts, participants select two "red" areas as priorities for improvement. This selection helps the groups to focus their energy and, for workers from small, high-risk facilities, helps reduce the sense of powerlessness. On the last day of the program trainees present their completed risk charts to the entire class and explain their choice of two priority deficiencies requiring improvement. Students openly discuss strategies and tactics to employ in achieving their goals. This discussion encompasses regulations and the use of regulatory agencies (eg, National Institute for Occupational Safety and Health [NIOSH], Occupational Safety and Health Administration, Environmental Protection Agency), health and safety committees and meetings, union health and safety departments, etc. The discussions also include the need for research and documentation regarding health and safety problems.

The final step toward achieving the program's long-term goals is the determination of specific action plans to be undertaken back at the plant. First, students discuss legal rights, regulations, resources, references, useful research and needed documentation, strategies, and tactics. Then, later in the program, participants meet again with their local union or plant and devise specific actions they intend to initiate to improve their chosen priority concerns.

Research Methodology

In 1989 the ICWU Center for Worker Health and Safety Education began an evaluation survey to determine the long-term effectiveness of its training programs. The ongoing evaluation for each wave of students consists of telephone follow-up interviews of trainees 12 months after training. For local union attendees the survey is conducted with one interviewee per site, whereas the survey attempts to interview every manager attendee who attends a joint labor-management program. The survey measures five major areas to determine the program's long-term effectiveness. These are (1) students' ongoing use of

resource and reference materials introduced during the training; (2) the amount of "secondary training" that occurred, that is, training conducted by participants for their coworkers at the work site following attendance; (3) trainee attempts and successes in obtaining changes in work site hazardous waste or emergency response programs, procedures or equipment; (4) posttraining improvements in the ways spills are handled at the work site; and (5) students' perceptions of training program effectiveness.

As of this date, 481 union respondents, each representing a distinct work site, and 50 management trainees have completed the follow-up telephone interviews. Interviews have been conducted by Cincinnati Bell's MATRIXX Marketing Inc. The response rate for primary local union group was 91.9% (481 of 523), whereas the rate for managers was 61.7% (50 of 81). This difference in response rate may reflect that union members were more likely to respond to a union survey, especially one that may highlight health and safety deficiencies at the work site.

Results

Demographics of Survey Respondents

The mean age of union and management respondents was 41.2 and 41.6 years, respectively. The cohort was predominantly male (87.7% for union members and 82.0% for managers). Racially, the survey group was 78.6% white (78.0% for managers), 6.7% African-American (4.0% for managers) and 1.5% Hispanic American (0% for managers). Racial or ethnic background was unidentified for 12.1 % of union members (18.0% for managers). In terms of education, 4.4% had not completed high school (0% for managers), 33.3% had a high school diploma (6.0% for managers), and 14.8% reported they had attended a trade or technical school (6.0% for managers). For union respondents, 30.4%, 3.5%, and 0.4% reported having attended college, graduated, or attended graduate school, respectively (30.0%, 20.0%, and 20.0%, respectively, for managers). Educational background data was not available for 13.3% (18.0% for managers).

Use of Resource Materials

One main goal of the Center's training is to provide students with relevant and accessible resource tools and to help them develop the skills necessary to use those tools. To evaluate the impact of this part of the training, interviewees are asked in the first part of the survey whether those who attended the training have used any of five resource materials since returning from the training. At the beginning of each training program, instructors ask students if they are familiar with any of the written resources used by the Center. Typically, less than 5% of the students (including managers) reported having ever seen these resources.

Table 1 is a summary of students' long-term use of the written resource materials introduced during training. The *NIOSH Pocket Guide to Chemical Hazards* was used by more than 85% of both union and management attendees. The Center's manual is used on an ongoing basis by three-quarters of all locals surveyed. Least used were Risk Charts: 43.9% of respondents reported using this tool. Responses by managers were comparable with those of union members.

Coworker Training

The second area addressed in the survey is the teaching of coworkers back at the plant by those who have attended the Center's programs (referred to here as secondary training). Without promotion or encouragement by the Center, this secondary training occurs outside of the Center's formal "train-the-trainer" program. This self-initiated training activity, therefore, indicates the ability of the Center to tap successfully into students' motivations to share health and safety information and skills with fellow workers.

Nearly 8 out of every 10 local union interviewees (78.4%) report that trainees from their local have taught co-workers about subject matter covered during Center training programs (72.0% for managers). The average number of coworkers taught was 70.0 for local union respondents (54.1 for managers) and the average length of training per coworker taught was 9.7 hours for union members (12.4 hours for managers). Overall, the 481 separate local unions that responded to the questionnaire have provided training to 26,390 coworkers.

A striking finding of the survey is that, to a significant degree, secondary training involves union attendees educating their supervisors. Each respondent indicating that secondary training had occurred was asked, how many, if any, of those taught were members of management. More than half of the local unions reported training their managers (52.2%, n = 191, mean number of managers taught per site was 10.0). Center-trained managers trained other managers at an even greater rate (82.3%, n = 30, mean number of managers taught per site was 12.5).

If respondents reported the occurrence of secondary training they were then asked the subject matter of the training. Table 2 shows that the issues covered during coworker training mirror the Center's training curriculum.

Attempts and Successes in Getting Work-Site Changes

The third area of the survey is a series of questions about workers' attempts to improve company programs, practices, and equipment. The 11 survey areas for possible change are shown in Table 3 and include emergency response drills, supply and fit-testing of respirators, chemical labeling, and the availability and use of chemical information. For each item, the questioning sequence begins with whether or not the trainee and their local union attempted to get the company to institute changes following training. Possible response included (1) yes, local union attempted to get changes, (2) no, there was not an attempt, or (3) no attempt was made because there was no perceived need for changes in this area. For each "yes" response, interviewees are then asked whether or not the improvements were (1) made by the company, (2) not made, or (3) "in progress."

Table 3 shows responses from both union and management respondents with respect to attempted change for the 11 subject areas. For union members, responses ranged from a low of 43.3% of those local unions that attempted to get improvements in the availability of Level A chemical protective suits, to a high of 76.0% of local unions who attempted to get the company to provide more chemical health effects training for workers. Change attempts by management trainees, although substantial, lag behind union members' attempts in areas not specific to hazardous waste/emergency response. Managers attempt rates more closely

resemble local union rates in HAZMAT-specific areas, including Level A and Level B chemical protective suits, emergency response drills, and proper decontamination.

Although the management data set is too small to undertake a rigorous statistical analysis, it appears that the difference in the rate of attempted change is, in part, rooted in differing perceptions between the management and the local union groups regarding the need for change. Table 4 shows a comparison of union and management responses in the “no need” category. Most striking is the comparison of reports of “no need” for improvements in the category of training on health effects of chemical exposures. Management expressed satisfaction with the “status quo” at a rate more than 3.5 times that expressed by union trainees. On the other hand, for the categories covering chemical protective suits, local unions’ and managers’ “no need” response rates were comparable.

Table 5 shows the success rate for those seeking improvements in the 11 areas investigated with success defined as a “yes” response to the question of whether management has responded to the specific requests or the response of management is “in progress.” As indicated, across all 11 targeted areas, respondents reported high rates of success. Whereas an attempt for improvement in “Level A” chemical protective suits was successful in less than half of the cases, more than 9 of 10 interviewees who attempted to get improvements in labeling of chemicals reported success. Although the sample is relatively small, it would appear that even though managers report a lower rate of attempts at change, they report a higher rate of success than do union respondents in each of the 11 categories.

Aggregating the 11 categories, 96.9% of union (466 of 481) and 92.0% of management (46 of 50) respondents attempted to obtain improvements in one or more areas. Local union attendees averaged change attempts in 6.8 categories per site, whereas management attendees averaged 5.1 attempts. Following these attempts, 97.4% of local union attendees making attempts succeeded in promoting change in one or more categories (454 of 466 sites attempting change). Management was successful in one or more categories 95.7% of the time (44 of 46 sites attempting change). When all sites were included (ie, whether or not they attempted to get changes), local unions averaged 5.0 successes (“yes” or “in progress”) per site. This represents a program-wide total of 2426 changes in health and safety programs, equipment, or training.

Handling Spills

The fourth interview area questions the effects of the training program on handling spills and releases at the work site. Respondents were asked whether or not a “serious chemical spill or accident” had occurred in the 12 month follow-up period. One or more spills were reported by 20.6% of union respondents (99 of 481 locals) and by 26.0% of management respondents (13 of 50). In total, workers at these sites reported 342 serious chemical spills or accidents.

When those who reported spills were asked whether the spills were handled differently because of the training, 57.6% of the workers (57 of 99) and 61.5% of the managers (8 of 13) said yes. According to local union reports, these findings suggest that the Center’s programs have positively affected the handling of 210 serious chemical spills or accidents

that occurred in the 1 year following training. Table 6 gives a breakdown of the specific spill response steps reported to have improved as a result of the training.

To illustrate better the potential significance of these findings, a series of more detailed questions regarding spills was added to the interview instrument in June of 1992. To date, 204 local unions have responded to this additional sequence of questions. Thirty-nine of these locals (19.1%) have reported 66 separate spills. Of these spills, 90.9% were characterized as either having caused (n = 21, 31.8%) or having the potential to have caused (n = 39; 59.0%) serious injury or damage. Respondents were also asked to indicate the size of the spills. For 34 of the 66 spills, the size was both known by the respondent and was quantified in liquid volume (others were unknown vapor or gas releases or were quantified in pounds). Twenty-one of these 32 liquid spills were of more than 50 gallons (61.8 %) and the mean spill volume was 829 gallons.

Additional qualitative data have been obtained on 32 of these spills. A sampling of verbatim responses about the chemicals and quantities spilled, causes of the accidents, and worker's comments regarding the spills and the Center's training are presented in Table 7.

Improvements in Preparedness

The final area of the survey addressed attendees' perceptions of the effects of the Center's training programs on their ability to handle hazardous chemicals and emergencies. Of union respondents, 90.9% said they are either "much better prepared" (64.7%) or "somewhat better prepared" (26.2 %). Manager reports were similar; 82.0% said they were either "much better prepared" (54.0%) or "somewhat better prepared" (28.0%). A much smaller percentage of respondents (9.1 % for union members and 18.0% for managers) indicated that they were either "only slightly better prepared" or had "no change."

Discussion

Fundamental goals of the program were to provide students with useful tools and to help students develop the skills needed to use them. Respondents have indicated clearly that the six major reference materials introduced during the program were used following training. Although Risk Charts were the least used of all the program materials evaluated, more than 40% of local unions reported posttraining reference to these tools. Risk Charts were intended to assist workers and managers in the evaluation of work-site problems and in setting and achieving goals for change. The Center's instructors have observed the positive effects of Risk Charts on initial planning by trainees.

A remarkably high percentage of both union and management attendees are providing training to their co-workers following attendance at the ICWU Center. To our knowledge, the practice of rank-and-file workers training both workers and management on such a broad scale is unprecedented. This practice not only marks substantial progress in the cooperative sharing of knowledge and information between labor and management, but is a recognition of the central role to be played by workers in the educational process. The data show that the topics of coworker training mirror those taught at the Center, indicating that the Center's program serves as a useful model for workers.

One of the most important long-term goals of the training program was the fostering of improvements in health and safety conditions at the work site. Typically, union workers have limited access to the decision-making process regarding these issues. Even when workers are part of this process, the ultimate decision regarding whether or not to make improvements is management's. Therefore, success in achieving these objectives was measured as both attempts at change and the results of those attempts. Both management and union trainees reported large numbers of attempts in the broad range of 11 plant site conditions. However, a larger percentage of unions reported change attempts (ie, ranging from a high of 76.7% to a low of 48.0% for the 11 categories) than did management (ranging from a high of 58.0% to a low of 32.0%). Overall, more than 90% of both union and management respondents reported that changes were attempted by trainees in one or more categories. The difference in reporting attempts between union and management is consistent with the higher rate of reporting "no need for change" by management. As could be expected, management reported a higher rate of success when changes were attempted, although the success rate for both union and management was very high.

A majority of those sites that reported a major spill in the first 12 months following training indicated that the education program positively affected the way spills were handled. The specific information gathered on the spills that occurred indicates that the accidents range from those that affected the lives and health of a few workers to those affected an entire community.

The improvement in both individual and work-site competency implied in the spill response data is corroborated by the broader measure of students' perception of improvement in preparedness. The majority of students state that following the Center's education program they are better prepared to deal with hazardous materials.

Conclusion

Given the apparent success of the program in meeting both its long-term and short-term objectives, it may be instructive to review briefly those aspects of the program that are believed to be primarily responsible for this success. The Center formulated its programs using the principles of learner-centered adult education aimed at empowering workers to affect health and safety conditions at their workplaces. This program did not limit its goals to affecting individual behavior changes, but included within its mission helping workers bring about institutional and programmatic changes at the work site. With this in mind, particular attention was paid to the makeup of each class. The Center encouraged attendance by groups of three or representatives from each work site and discouraged attendance by lone individuals. It was hoped that these small groups of students would have existing relationships with each other within the local union, and, through the local union, with the company. Optimally, this group of workers would continue to see each other on a regular basis, associate as a local union group focused on the goals that were set at the training program, and provide each other with needed support and trust through the often difficult task of pushing for improvements. Representation from 6 to 12 sites at each program fosters mutual support and exchange of ideas among workers from different sites. This support was

necessary for developing and reinforcing commitment to the local union's self-determined goals for achieving change.

Bringing workers from their employment sites to the Center and their knowing that the program involves hundreds of other sites helps participants feel they are a part of a larger movement. It also allows them to focus on the program without distractions and to reach beyond the limits that might restrict their thinking if the program were convened at their work site. For example, if the training program were held at each work site, this would preclude the opportunity for synergistic interaction across work sites that characterized virtually every session of the curriculum. Additionally, the Center's fixed site and the stable and highly skilled administrative and teaching staff are a permanent resource that have not been present in other health and safety training programs for these workers.

This Center has benefited from being directly connected to the six unions. The program was built on the labor movement's historic foundation of advocacy for change in working conditions. Preexisting relationships between the local unions and their international organizations, and among the unions and companies provided a sound basis upon which changes could be proposed.

A shared union ethic and similar employment experiences establish a basis for empathy, effective communication, and mutual support among workers involved in this project. To tap into these strengths, the Center has involved rank-and-file workers in every aspect of the program. For example, the Center has ensured a strong representation of rank-and-file workers among full-time instructors. The Center also assembled and prepared a large group of rank-and-file workers to take on the role of Associate Instructor. Associate Instructors have assisted staff instructors on a regular basis while on short-term leave from their work sites. Typically one or two Associate Instructors assist at each session.

The means by which the Center developed its programs was another key element leading to success. Although the program staff initially included only two full-time instructors, the Center chose to employ a full-time education director to provide needed leadership and guidance in the development of education materials and methods. The Center also saw the position of education director as critical both for fostering instructor growth and development and for ensuring the quality of the education process on an ongoing basis.

The Center designed and built its programs using a participatory process that involved a team composed of rank-and-file leaders in health and safety, program staff, and consultants. This group provided guidance during program conceptualization, they critically observed initial program pilots, and, following long and detailed discussions with participants, they recommended modifications regarding the curriculum, materials, and methods. This program revision process went through several iterations. Collectively, this group helped to ensure that the program was responsive to the needs of workers, was technically accurate, and was capable of achieving program goals.

Following from this developmental model, the program was participatory and interactive. These characteristics were, in part, a result of small group education methods that were chosen to be the central framework for classroom activities. These methods allow for

improvisation within the context of predetermined program content requirements to ensure that the program addresses trainees' real needs. Extemporization around central themes gives the program life and contributes to the sense of ownership that is energizing for both students and staff. In addition, the educational processes simultaneously addressed hazardous waste and emergency response skills and problem-solving involving real workplace conditions. Rather than focus on information recall, process-oriented training methods seek to build self-reliance that stresses knowing when additional information is needed, where to find it, and how to interpret and use it. This approach is better suited to supporting workers' own motivations rather than trying to motivate workers to achieve goals set by program administrators.

Particular attention was also paid to making the program nonthreatening. For example, the Center rejected the common practice of measuring successful completion of the course on an individual pass-fail basis that stressed written tests. As an alternative, the Center reinforced group rather than individual performance by using anonymous pretests and post-tests with a grouped analysis of scores. This approach was designed to measure the program's overall success, including the effectiveness of education materials and methods, and the performance of instructors and students.

Equally important to "hands-on" education methods used in the classroom were "hands-on" activities with personal protective and emergency-response equipment, including simulations. This spectrum of educational activities ensured that the program relied on the full range of skills and experiences that students brought to the training.

The Center's course agenda was designed to be rigorous and challenging and to require a substantial mutual investment by both students and instructors. It was believed that this mutual investment would contribute to a heightened commitment to individual local union and overall program goals.

Although the primary focus of the design of this program was to facilitate the learning and empowerment of union workers, the educational methods used have also proven effective in the joint labor-management sessions periodically conducted at the Center. Thus, this program suggests that a union-sponsored program that puts union and management trainees on an equal standing can encourage management to work with rank-and-file workers to succeed as agents for positive change.

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Appendix

Overview of Training Program Curriculum and Methodologies*

Session	Content	Instructional Methodologies	Objectives
Introduction	Skit about spill-related health and safety issues followed by discussion, listing of chemicals of concern to students, common health and safety problems and program goals. (1 h, 15 min).	Role play by instructors, followed by discussion of workplace safety, training and exposure issues.	Ice-breaker. Values workers' experience, encourages participation, clarifies student training needs.
Hazard Recognition: Labels and Placards	Chemical labeling systems and use of DOT and NFPA Hazardous Materials Guide Books. (1 h, 15 min).	Small group research and problem solving exercise with report-back.	Hands-on use of reference books raises ability to evaluate in-plant labeling. Improves skills, confidence.
Comparing Resources	MSDS, NIOSH Pocket Guide, and New Jersey Factsheets. (1 h, 30 min)	Small group research exercise comparing information derived from three chemical reference materials. Followed by report-back and discussion of content findings and evaluation of the resources.	Teaches students how to critically read chemical reference materials and to seek clarification of conflicting information. Raises awareness of basic toxicologic concepts, chemical measurement and exposure limits as well as providing interpretation of physical characteristics of chemicals.
Incompatible Chemical Reactions	Chemical reactivity, confined space entry, emergency response procedures, PPE. Requires use of chemical dictionary, NFPA Hazardous Materials Guide. (1 h, 15 min)	Small group research and problem solving exercise based upon true stores of workplace fatalities followed by incompatibles demonstration.	Raises awareness of chemical reactivity and ability to use reactivity information as provided on MSDS and other information sources. Introduces confined space entry procedures. Requires use of reference materials and group decision-making.
Emergency Response Planning	Principles of emergency response decision-making, basic do's and don'ts, need for planning and research. (1 h, 15 min)	Small group response and rescue planning based upon accident scenario. Requires research and justification of decisions. Some interactive lecture presented by chemical response specialist.	Builds upon research skills. Stresses the importance of planning, training and informed decision-making.
Toxicology	Basics on acute/chronic effects, routes of entry, dose response, body systems, target organs, carcinogens, mutagens, and reproductive hazards. (2 h, 30 min)	Learner-directed interactive discussion with questions and answers on specific topics used to facilitate teaching of broader toxicological concepts.	Raises awareness and encourages continued use of reference materials. Clarification of mechanisms of exposure and effect. Provides impetus for behavior and workplace changes.
Respiratory Protection	Selection and limitations of air purifying respirators, OSHA Respirator Standard, supplied air respirators. Provides initial hands-on experience with self-contained breathing apparatus. (3 hr)	Lecture, demonstration and hands-on.	Raise awareness and ability to critically evaluate workplace use of respirators and compliance with good practice and OSHA standards. Stresses need for regular workplace training and drills using plant equipment. Physical hands-on training encourages action, breaks "class-

Session	Content	Instructional Methodologies	Objectives
			room atmosphere" and values nonclassroom skills.
Chemical Protective Clothing (CPC)	Selection, limitations, problems and requirements of CPC. (1 h, 30 min)	Show and tell with interactive discussion, questions and answers, and research practice.	Raises awareness and ability to assess use of gloves and other CPC. Introduces basic research skills for CPC selection. Encourages action on acquiring PPE and related training at work site.
Dress-Out, Drum Handling, and Plug and Patch Techniques	CPC dress-out and techniques of drum, valve and pipe plugging and patching. (1 h, 30 min)	Hands-on/team work	Breaks up classroom work and values work skills of students. Raises awareness of difficulties of response activities and need for ongoing emergency response drills.
"What's Wrong With This Scene?"	Review of selection and procedures for respirators and PPE for emergency response. (45 min)	Small group exercise with general speak-out and report-back.	Practice research skills; evaluation of emergency response plans and procedures. Reinforces understanding of air purifying respirators and ability to assess workplace respirator programs.
Decontamination	Stresses need for practice of and limitations of decontamination procedures. (1 h)	Interactive lecture, slide presentation with questions and answers.	Raises awareness and ability to critically evaluate plant decontamination practices.
Using OSHA Standards: HAZWOPER (1910.120). (1 hr), Hazard Communication and Access to Records (1910.1200 and 1910.20) (1 h, 30 min)	Basics of OSHA rights and process; how to read an OSHA standard and the major points of the three standards.	Sessions involve small group research and decision-making to answer problems of interpretation of OSHA standards.	Improve understanding of OSHA rights, build skills needed to read standards, encourage evaluation of work-site compliance.
Spill Response Simulation With Follow-Up Evaluation	Research to select PPE and plan response to chemical spill simulation. Hands-on plug and patch of leaking pipes and drums, full decontamination procedures. (4 h, 30 min)	Hands-on simulated response with viewing and discussion of video tape of exercise.	Raises awareness of difficulty of response activity waring full PPE. Encourages team work and values students' skills. Increases students' ability to evaluate emergency response plans and training at work site. Allows students to synthesize newly acquired information and skills. Encourages participation in company's emergency response program.
"Spill Drill" Video and Discussion on Union, Company, and Community Issues	Problems and obstacles to safety and health improvements, the job vs health dilemma, and community/union jobs vs environment conflicts. (1 h)	Interactive video with discussions following each of three segments. Small groups devise a policy and press release concerning union's role in environmental dispute.	Encourages exploration and discussion of labor/management/community conflict and potential for joint action over handling of hazardous chemials. Broadens issues and options for involvement in community and joint labor-management efforts to increase worker and public protection. Values each student's opinions.
Risk Chart Evaluation and Determination of	Evaluation of plant's health and safety training, pro-	Small plant specific groups (union *or* labor	Values workers' judgment of plant conditions. Encour-

Session	Content	Instructional Methodologies	Objectives
Priorities for Improvement	grams, conditions, PPE, work practices, and spill response preparedness. (1 h, 15 min)	and management) discuss and evaluate their company's health and safety conditions using a visual chart to distinguish areas in which policies and practices need improvement.	ages "at work" use of skills and knowledge gained in training. Group decision-making on priorities focuses attention and efforts. Risk chart becomes a planning tool to map out changes needed and a report card to monitor accomplished changes at workplace.
Strategies for Change	Exploration of wide range of strategies, tactics, and resources for improvement that encourage active involvement in union, workplace, and community. (1 h)	General open discus sion with note-taking and summary that follows Risk Charts. Discussion session sequence: Evaluation of plant Selection of priorities Ideas for affecting changes Obstacles to Change Strategies for change	Encourages involvement and exchange of ideas. Provides participants with range of concrete actions. Allows participants to organize problems and make improvements achievable. Encourages a commitment to action (including education of coworkers).
Specific Action Plans for Change	Locals or plants determine actions they will undertake to achieve improvement in two priority areas of concern. (1 h, 30 min)	Small group exercise and discussion. Each local or plant writes an action plan and reports upon exact steps they intend to take to achieve priorities selected.	Focuses efforts and encourages involvement and long-term follow-through on health and safety issues.

* Abbreviations used are: DOT, Department of Transportation; NFPA, National Fire Protection Association; MSDS, Material Safety data sheet(s); PPE, personal protective equipment; OSHA, Occupational Safety and Health Administration; CPC, chemical protective clothing.

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TABLE 1

Percentage of Trainees (Sites) Reporting Use of Training Materials Following Program Attendance

Training Material*	Union Members (N = 481)		Management (N = 50)	
	n	%	n	%
NIOSH Pocket Guide	423	87.9	43	86.0
Center's Training Manual	363	75.5	35	70.0
NFPA Hazmat Guide	343	71.3	46	92.0
New Jersey Factsheets	328	68.2	30	60.0
DOT Emergency Response Guide	295	61.3	34	68.0
Center's Risk Chart	211	43.9	18	36.0

*NFPA, National Fire Protection Association; DOT, Department of Transportation.

TABLE 2

Issues Covered in Coworker Training

Issue Included in Coworker Training	Union Members N = 377*		Managers N = 36*	
	n	%	n	%
Hazard recognition/chemical identification	354	93.9	33	91.7
Chemical protective gloves and clothing—selection and use	337	89.4	33	91.7
Respirator selection and use	313	83.0	29	80.6
Use of reference materials	305	80.9	27	75.0
Health effects of toxics	302	80.1	31	86.1
Health and safety laws and regulations	305	80.9	25	69.4
Storage of incompatible chemicals	296	78.5	29	80.6
Emergency response planning/procedures	263	69.8	28	77.8
Decontamination	203	53.8	27	75.0
Spill containment techniques	170	45.1	24	66.7

*Only includes those union members and nonunion managers who reported that training occurred at their work site.

TABLE 3

Percentage of Sites Attempting to Get Improvement in Plant Conditions or Programs

Targeted Condition/Program	Union Members N = 481		Management N = 50	
	n	%	n	%
Health effects training	369	76.7	27	54.0
Availability of MSDSs: other chemical information*	329	68.4	21	42.0
Labeling of chemicals	322	66.9	24	48.0
Respirator: supply	303	63.0	21	42.0
Respirator: fit testing	343	71.3	27	54.0
Respirator: training	339	70.5	28	56.0
Gloves: supply	301	62.6	16	32.0
Level B chemical suits: supply	239	49.7	21	42.0
Level A chemical suits: supply	198	41.2	22	44.0
Emergency response drills	315	65.5	29	58.0
Proper decontamination	231	48.0	21	42.0

*MSDS, material safety data sheets.

TABLE 4

Perception of Need for Improvements in Plant Conditions and Programs

Targeted Condition/Program	Union Members N = 481		Management N = 50		%Mgmt/ %Union
	n	%	n	%	
Health effects training	49	10.2	18	36.0	3.6
Availability of MSDSs: other chemical information	118	24.5	24	48.0	2.0
Labeling of chemicals	114	23.7	20	40.0	1.7
Respirator: supply	132	27.4	21	42.0	1.5
Respirator: fit testing	88	18.3	18	36.0	2.0
Respirator: training	85	17.7	16	32.0	1.8
Gloves: supply	146	30.4	28	56.0	1.8
Level B chemical suits: supply	150	31.2	19	38.0	1.2
Level A chemical suits: supply	161	33.5	18	36.0	1.1
Emergency response drills	68	14.1	16	32.0	2.3
Proper decontamination	111	23.1	17	34.0	1.5

TABLE 5

Percentage of Sites Reporting Success* Following Attempts to Improve Plant Conditions/Programs

Area Targeted for Improvement	Union Members			Management		
	N	Yes	In Progress	N	Yes	In Progress
		% (n)	% (n)		% (n)	% (n)
Health Effects Training	369	57.2 (213)	19.2(71)	27	59.3 (16)	29.6 (8)
Availability of MSDSs: other chemical information	329	81.2 (267)	5.2 (17)	21	71.4 (15)	23.8 (5)
Labeling of chemicals	322	79.8 (257)	10.6 (34)	24	75.0 (18)	16.7(4)
Respirator: supply	303	71.9(218)	8.9 (27)	21	81.0 (17)	19.0(4)
Respirator: fit testing	343	68.5 (235)	10.8(37)	27	81.5 (22)	7.4 (2)
Respirator: training	339	67.6 (229)	10.3 (35)	28	82.1 (23)	10.7 (3)
Gloves: supply	301	76.4 (230)	9.6 (29)	16	93.8 (15)	0(0)
Level B chemical protective suits: supply	239	39.7 (95)	11.7(28)	21	66.7 (14)	14.3 (3)
Level A chemical protective suits: supply	198	31.3 (62)	12.6(25)	22	63.6 (14)	22.7 (5)
Emergency response drills	315	42.5 (134)	16.8(53)	29	58.6 (17)	31.0(9)
Proper decontamination	231	41.6 (96)	14.7 (34)	21	57.1 (12)	19.0(4)

* N = respondents who have answered “Yes” to the question, “Regarding (*issue*), have the union members who attended the Training Program tried to get the company to make improvements since your training?” “Yes” and “In Progress” responses reported in this table are from follow-up questions: “Regarding (*issue*), has management responded to your efforts to make these improvements?” Both “Yes” and “In Progress” are defined as success.

TABLE 6

Improvements in Handling Chemical Spills/Accidents Following Program Attendance

Area of Improvement	Union Members N = 57 sites		Management N = 8 sites	
	n	%	n	%
Respiratory protection	44	77.2	8	100
Investigation of spills	44	77.2	6	75.0
Coordination of response team	44	77.2	6	75.0
Spill containment techniques	42	73.7	8	100
Protective clothing	40	70.2	8	100
Decontamination procedures	32	56.1	7	87.5

TABLE 7

Reports on Specific Spills, Emergency Responses, and Training

Chemicals Involved	Amount of Chemical Involved	Cause of Spill or Accident	Comments Regarding Accident and Training
Hydrogen fluoride	Unknown to respondent	There was a leak in the system and the chemical entered the atmosphere. There was property damage to the building and also to vehicles.	After the training, we established an emergency response team.
Ammonia, tar, and liquor	5,000 gallons	There was a leak in the line and tar and liquor were released and got all over the place. Natural gas built up and exploded.	Much more training is being done in regard to gas leaks. I would like to see more people go to the training program.
Benzene	Escaping vapors only	The floating roof of the one million gallon tank tipped, releasing the highly flammable fumes.	As a result of the training we have better equipment and better decontamination. Everyone was able to go in and do their job in the proper manner.
Titanium tetrachloride	1,500 gallons	There was a bad valve.	The training helped by informing the safety committee about the chain of command. We are better prepared and coordination through all departments has improved.
Amine	55 gallons	A truck ruptured a drum. The leaking chemical caused an eye injury.	The training improved the accident investigation and follow-up. It also improved our awareness of decontamination.
Hydrofluoric and sulfuric acids	10,000 gallons	One waste line broke underground and another line plugged up underground. It was a breakdown or preventative maintenance.	The training helped us develop a better structure in our response to spills. We are just more professional. We're able to communicate with management a little bit better and we're better able to handle spills.
Trichloroethane	30,000 gallons	Lack of training.	We were able to go in and find out the causes. We looked over the procedures and we ensured that the procedures were followed and that workers were properly trained. We think the training was very valuable.
Chlorine Gas	Unknown to respondent	A valve malfunctioned and a line just broke.	I was impressed with the training.
Methylene bisphenyl isocyanate	400 gallons	The coupling broke.	Following training the proper equipment was issued. Everything was done by the books. We have come a long way since we formed a team. The training was worthwhile. We don't have to worry about the company, now we can judge for ourselves what we need.
Sulfur dioxide (three separate leaks)	Unknown to respondent	The valve did not operate properly. The members	We could talk to management and feel we had bet-

Chemicals Involved	Amount of Chemical Involved	Cause of Spill or Accident	Comments Regarding Accident and Training
		were not trained properly and didn't have the right respirators.	ter information than they did. They took notice and started to listen to what we had to say. They knew we had to put the improvements into the budget and we did get the improvements.