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TRAINING WITHIN INDUSTRY AS SHORT-SIGHTED COMMUNITY LITERACY-APPROPRIATE TRAINING PROGRAM: A CASE STUDY OF WORKER-CENTERED TRAINING AND ITS IMPLICATIONS

Dirk Remley

This essay presents a case study of the modes used in training employees at a munitions plant in Ohio between 1940 and 1945. Theories of multimodal discourse and learning advanced by The New London Group (1996), Gunther Kress and Theo Van Leeuwen (2001) and Richard Mayer (2001) inform this analysis. With an unskilled labor force and many workers coming from oral literate traditions, the War Manpower Commission developed the Training Within Industry program, emphasizing visual and experiential literacies. This analysis can inform programs that use multimodal forms of instruction by acknowledging positive and negative implications of such literacy sponsorship.

“Exploring creatively the need for social connectedness of institutions, such as schools and youth organizations, as well as the workplace, offers us ways to create and tell new stories. As we do so, we have to acknowledge that what may seem limits or losses can be beginnings as well as endings.”

(Shirley Brice Heath, Ways With Words, “Epilogue 1996,” 376)

INTRODUCTION

With these final words to her 1996 edition of *Ways with Words*, Shirley Brice Heath invites researchers to consider the implications that workplace literacy practices have on community literacy patterns. However, so much literature about workplace literacy practices revolve around the reading and writing associated with task-specific performance without learning much beyond that performance, minimizing the cognitive processes required of the reading and writing (Diehl and Mikulecky, 1988; Graff, 1995). Reading and training at work are focused on particular tasks, and there are many extralinguistic cues used in training to assist in understanding a given task. Because of these cues, differences in cognitive patterns among workers are mitigated as a negative influence on their work performance relative to understanding their job. This paper discusses a training approach used to address such issues in a historical context, though the approach is encouraged today as well; consequently, it also introduces social implications of such an approach in the current global economic environment.

The purpose of this analysis, therefore, is to raise awareness about the ways that certain literate practices, while creating efficiencies, can negatively affect literate development and social advancement. The principal research question in this study is: What modes were used in training programs at the Arsenal, and what factors influenced them? Related research questions include:

What perceived gaps existed between the literate backgrounds of workers hired into a given job had and the literate practices those workers employed in the workplace? Which modes were emphasized and why?

In *Literacy in American Lives*, Deborah Brandt observes the changes that literacy standards have experienced over time; for example, where a college degree in the 1960s suggested that one had strong print-text reading and writing skills, a college graduate today is expected to have considerable computer literacy skills. Many studies of late have also discussed the benefits of integrating multimodal approaches to training and learning activities (New London Group, 1996; Mayer and Moreno, 2000; Mayer, 2005; Mishra and Sharma, 2005, Gee, 2003). In *What Video Games have to Teach us about Literacy and Learning*, James Gee observes the value of virtual gaming technologies in training programs. Such technology emphasizes visual and experiential modes in learning. The different modes involved can reinforce certain attributes of the instructional message providing multiple means by which learners can acquire knowledge. However, fewer studies have documented the relationship between the modes that are integrated into a single training program and social and political factors that affect such decisions. Researchers are still trying to understand under what conditions a certain combination of modes will best work and the ramifications of such decisions. In *Multimodal Discourse*, Gunther Kress and Theo Van Leeuwen identified different strata of multimodal discourse as a means by which certain decisions involved in a communicative act can be discussed. These strata include: discourse (socially constructed knowledge of reality), design (semiotic resources/modes by which communication occurs), production (actual material means of expressing message), and distribution (how message is disseminated). Kress and Van Leeuwen acknowledge that no stratum supersedes any other stratum, but that there may be situations when certain combinations of these strata and dynamics therein (e.g.: modes) communicate better than other combinations.

Further, in “A Pedagogy of Multiliteracies,” the New London Group observes that there may be contexts in which the visual may be more powerful than other modes. Also, they state that, “...language and other modes of meaning are dynamic representational resources, constantly being remade by their users as they work to achieve their various cultural purposes” (64). This study analyzes modes used in training practices at a particular munitions plant in Ohio during World War II (WWII). Much of the training used at munitions plants around the United States at that time was developed by the Training within Industry organization and implemented by the plant operators to train employees at war-related factories during WWII. The training philosophy developed by those who created the TWI program has been espoused as one that can lead to more efficient production methods, and Jeffrey Liker and David Meier, in *Toyota Talent*, acknowledge its implementation at Toyota. Specifically, this analysis examines the relationship between modes of representation and exigencies involved in the context dynamics at the time. It uses this particular arsenal (Arsenal) as a historical case study of how these modes were used in a particular workplace within this context. In

the “Introduction to Historical Studies of Literacy,” Harvey Graff espouses historical studies of literacy in context that may illuminate repercussions of certain practices; he asserts that, “Social attributes...and historical contexts, which are shaped by time and place, mediate literacy’s impacts, for example, on chances for social or geographic mobility” (125). By considering the original context in which the program was developed, literacy scholars can understand a specific case in which employers adjusted literacy expectations to workers’ skills. Such analysis and understanding have implications in the current economic environment in which workers oftentimes need to relocate to areas and adjust to new language dynamics while learning to perform their work, as well as in a technological environment wherein virtual game technologies are incorporated into training programs.

Theoretical Grounding

Images are important to one’s cognitive understanding of abstract ideas and concepts and the relationship of image to text. While Rudolf Arnheim values image over words in *Visual Thinking*, W.J.T. Mitchell conveys equality between the two in *Picture Theory*, suggesting that value of one over the other depends on context. Kress and Van Leeuwen attempt to integrate the two into a single theory that considers the various unique attributes of each genre. Like the others they recognize the relationship between composer and ‘reader’ as an interactive one; the reader acts upon a message as much as a composer initiates it. Emphasizing ‘practice’ over creation and interpretation, they apply new terminology to the discourse of multimodality: discourse, design, production, and distribution (4-5). Furthermore, they articulate that the message is not just the content but its form relative to how it is presented and the interlocutors’ relationship to each other and their experiences.

In addition to the strata identified above, they use certain terms to explain the social interaction involved in making meaning. “Mode”

pertains to the delineation of the different genres of composition, such as visual, alphanumeric text, and aural. The term “medium” pertains to the material resources used to produce a message. “Experiential meaning potential” is also a new term that pertains to the roles that interlocutors’ past experiences play in contributing to making meaning out of a given message. Finally, “provenance” pertains to the importing of certain signs into different contexts to help interlocutors understand each other’s ideas and values (21-23).

Employers need to use multiple modes of communication to help train employees. Because training presents new information to employees,

Much of the training used at munitions plants around the United States at that time was developed by the Training within Industry organization and implemented by the plant operators to train employees at war-related factories during WWII.

the modes used to present the information need to make the information accessible to the trainee. This will likely involve understanding the trainee's past experiences—knowledge about some concept similar to that being presented and ways the trainee best learns new concepts.

Additionally, because this study focuses on training practices, the cognitive theory of multimodal learning developed by Richard Mayer and Roxana Moreno in *A Learner-Centered Approach to Multimedia Explanations* can be more specifically applied to the analysis of modes used for training purposes. In particular, in *Multimedia Learning*, Mayer identifies three “views of multi-media”: these include delivery media, presentation media and sensory modalities. All of these constructs are involved in this study, as they combine to effect the best learning among trainees.

Finally, Mayer identifies three potential learning outcomes: no learning, rote learning and meaningful learning. Reinforcing the findings of William Diehl and Larry Mikulecky, training tends to involve rote learning—learning to replicate certain actions/behaviors. Ultimately, Mayer characterizes multi-media instructional messages as communicating “using pictures and words intended to promote learning” (21). Mayer's multimodal principle is that people learn better when pictures and words are integrated into an instructional message than when only words are used (63). When only words are used people may attempt to “build a visual model,” but they may not attempt to do so. If a picture is provided, people can make the visual connection more readily. Empirical evidence that supports this assertion exists (72-78). Mayer also asserts that it is vital to eliminate extraneous material—words, images and sounds—from any multimedia message. Such irrelevant information “competes for cognitive resources in working memory,” disrupting the learner's ability to organize and retain relevant information (113). Additionally, in “An Integrated Model of Text and Picture Comprehension,” Schnotz explains that, relative to principles associated with working memory, visual images that integrate text are easier to process because fewer processes of working memory are involved.

Richard Clark and David Feldon, in “Five Common but Questionable Principles of Multimedia Learning,” challenge a number of commonly held beliefs about the effectiveness of multimedia learning. For the most part, they acknowledge that multimedia approaches may not work on all people because of individual differences in learning styles and the nature of information being presented (98). This suggests that a trainer should come to understand a learner's prior experiences with and knowledge about a given task so as to customize the mode of instruction accordingly. Also, Mayer observes that certain modes will facilitate certain learning outcomes better than others; while exclusively visual modes may facilitate rote learning, the same modes may not facilitate meaningful learning. John Dewey, in *Experience and Education*, asserts that people can best learn a given task, as well as certain cognition associated with certain tasks, through experiential learning.

In *Social Linguistics and Literacies*, James Gee asserts that how people read and think about a particular thing is determined by their experiences with certain social groups. Through social practices such groups “encourage people to read and think in certain ways, and not others, about certain sorts of texts and things” (2). Learning is a social practice; it occurs in some kind of social setting generally. Gee identifies a marriage between the semiotic domain and situated practice (26). Reading and writing print text is an example of a semiotic domain. Combining notions of socially-constructed learning and semiotic domains, this also brings to mind the importance of understanding a user’s existing literacies when using certain approaches/modes in training. How much time one needs in order to learn the new mode will affect how quickly he or she will learn the task being presented. It is important to understand modes in which trainees have learned previously.

Further, as Mayer and Dewey do, Gee connects prior experience and knowledge to learning. People learn by making connections between past experiences and new experiences (75-76).

RESEARCH DESIGN

This study is a historical case study. It uses the *Training Within Industry Report* and the Arsenal’s historical documents from the period 1941-1945, focusing on modes used in training. These documents include training manuals published in the 1940s and in the early 1950s. These artifacts represent the final version of documents that underwent revisions over the course of the time period included in this study and beyond it; consequently, I infer that actual materials used assimilated these materials, and I draw on the descriptions in the historical summaries of operations to assist in that. Further, historical summaries of operations and training manuals provide evidence of modes used in training. The documents that summarize the operations at the Arsenal from 1941-1944 are used as the principle source of ‘data.’ However, some of the Arsenal’s documents have been destroyed and, consequently, these documents do not convey certain information relevant to the information expressed in the Arsenal’s documents. Therefore, documents external to the Arsenal that report those dynamics are also used. In the Arsenal’s documents the Training within Industry program is identified as a primary provider of guidance with regard to its training programs. The TWI Report document serves as a primary source of information in understanding the specific programs that TWI implemented at plants throughout the country during WWII, and it serves as a secondary source of data relative to the training programs at the Arsenal in that it helps to understand some of the practices used at the Arsenal, bridging some of the gaps between data points that are available and acting to bridge contextual information not provided in the Arsenal’s actual documents but provided in historical scholarship about the period, which act as tertiary sources of data in this study.

WWII and the Arsenal

As the U.S.'s involvement in World War II began, the government looked for locations throughout the United States where it could establish plants that would produce ammunition and weapons. For security reasons, many of these locations were small cities that were away from the seaboard and experienced various weather patterns that would make reconnaissance difficult for enemies. Northern Ohio was one such location, and the U.S. government decided to build an ammunition plant within that area. Originally developed as two facilities—a manufacturing plant that would be operated by private industry, and a storage and shipping facility that would be operated by the Army—the Arsenal was built very quickly in 1941.

Much about the Arsenal was on a grand scale: According to its contractors' historical summaries, the construction project itself was considered the biggest of its kind to that point in history, and the production operations exceeded those of other installations. Indeed, Ohio History Central reports that it produced more ammunition between 1942 and 1945 for the war effort than any of the other fifty-nine installations in the country.

Labor Pools and Training

Within the first few years of WWII, it became evident that the specialized production efficiencies that had been adopted by industry in the 1930s would give way to the needs associated with a shortage of workers. In *Farm and Factory: Workers in the Midwest 1880-1990*, Daniel Nelson observes that, "World War II production relied heavily on additional labor and a more elaborate division of labor...most assignments could be broken down to the point that prior industry or product-specific experience was unimportant"(142).

Nelson states that, as the government recognized the problem of the mismatch between workers' skills and job requirements, "officials launched ambitious remedial efforts that became highlights of the mobilization experience (and)...the retraining of workers proved to be comparatively easy" (143).

A regular feature of the Arsenal's annual reports was an assessment of the labor market. According to these summaries, after the local labor market was exhausted within the first months of war, the Army recruited workers from all areas of the country for war-related work, and these people were bussed to the various sites. The Arsenal employed between fifteen thousand and nineteen thousand people during WWII, and many of these were migrants from West Virginia and the South.

Migrations of Appalachians to the Midwest began in the 1910s as migrants moved from Appalachian farming areas to farms in the Midwest. Stuart Hobbs, in the Forward to *Mountain people in a flat land: a popular history of Appalachian migration to Northeast Ohio, 1940-1965*, indicates that Kentuckians tended to move to Cincinnati and Columbus, while West Virginians moved to Akron and Cleveland (xi). In "Industrial Voyagers," Susan Johnson notes that, "more newcomers became homeowners and considered Akron their permanent home" (1). In fact, Carl Feathers, in *Mountain People in a Flat Land*, notes that, "by the

early 1920s Akron was the capital of West Virginia”(23). So, a social network for additional migrations had been established before WWII. Between 1940 and 1970, states Hobbs, about one million people would move from the mountains to Ohio; most were white, but about fifty thousand were African Americans (xiii).

As with the Appalachian migrants, African Americans migrated to the North in the early 1920s and through the 1930s. African Americans had worked mostly in meat packing plants, steel mills, and foundries; and they found similar work in the North. James Rodabaugh acknowledges that in 1940 African Americans accounted for 2.5% of the total employment in war-related industries, and in 1945 they accounted for 8.2% of total employment in war-related industry (316). The labor shortage caused many industries to relax discriminatory hiring practices. In the “World War II” *FMC Program Segment*, Ben Wattenburg acknowledges that President Roosevelt issued an Executive Order prohibiting discrimination in defense jobs or government. The lure of well-paid jobs pulled African-Americans out of the South and into the war plants in the North and West.

Most migrants who took housing in the village near the Arsenal were Appalachians who rented in the government housing project, built as temporary housing (generally characterized as not to exceed a useful life of ten years), and from local residents. There were very few African-American migrants who came to that village, though those who did come were also housed in the same development. Shirley Brice Heath and Victoria Purcell-Gates have documented the oral literate traditions of Southern African Americans and Appalachians. Prospective workers were bussed to the Arsenal for interviews and signing of employment papers, and then moved on to training.

According to the Arsenal’s historical documents, officials from the Arsenal attended a conference hosted by the Cleveland office of “Training within Industry”, a subdivision of the Office of Production Management. This November 1941 conference helped generate a number of recommendations regarding the training of workers (Historical Summary, 1944; 93). TWI also was involved in providing some of the actual training (112). Based on information about the training programs, these recommendations attempted to minimize the need for literacy skills among workers, understanding their varied literate backgrounds and their transient nature.

Training within Industry

As acknowledged in the *TWI Report*, The Training within Industry (TWI) program provided consultation and actual training to various facilities throughout the U.S. during WWII. Its most basic founding principle was that “What to do is not enough. It is only when people are drilled in ‘how to do it’ that action results” (xi). The most basic objective of the program was to train workers quickly to produce defense materials in order that such training, efficient in itself, would result in efficient and quality production. The report acknowledges that

The training we give the worker... can be more than an expedient means of getting the job done. It can be suitable to the individual and in line with his native talent and aspiration. Then it becomes education because the worker...trained in accordance with his talent and aspiration, is a growing individual. (xii)

An important consideration in Mayer's theory is the accounting for individual differences based on learners' experiences and knowledge prior to receiving instruction. Kress and Van Leeuwen posit that production of meaning includes 'experiential meaning potential'. They state that, "humans have the ability to match concepts with appropriate material signifiers on the basis of their physical experience of the relevant materials" (75). Learning tends to occur by doing, and the more experiences one has with a given set of procedures, the more he or she can understand certain routines; the TWI program emphasizes these attributes of semiotics.

These principles were needed in order to address the lack of training in production that many of the nation's unemployed had at the time. The report acknowledges that while vocational schools could provide some training to prepare such workers for war-related production, "not even the best school could bring them up to the level of production proficiency that would be required by the demands..." (3).

Using a standard method by which few people could be trained and then share their own training with others (using a 'multiplier principle') was encouraged (6). This method involved training by doing. According to the *TWI Report*, "People have to learn to do jobs. They can learn by being trained or they can learn through mistakes...Learning by doing is good, planned training...Training is a multiplying process—one person's 'know-how' and 'can-do' spread to many." (17). According to the Report, plants were surveyed to ascertain workers' skills and backgrounds in production work. Upon realizing a great gap between this background and the work they would be doing, based on an extensive study of the operations involved in lens-grinding (Appendix), TWI developed a program to quickly train workers by breaking down jobs into simple processes (21). After operations were broken down into simpler tasks, training on each task would include the following instruction:

1. Show him how to do it
2. Explain key points
3. Let him watch you do it again
4. Let him do the simplest parts of the job
5. Help him do the whole job
6. Let him do the whole job—but watch him
7. Put him on his own (19; 21)

Another principle put into place was that of upgrading through experience. Workers who had gained expertise at a certain level could be upgraded into higher levels. Finally, TWI developed a package of training programs that developed supervisory instruction as well as job instruction programs (30).

Generally, the following four essential elements were presented to plants:

1. The training program should be one of utter simplicity.
2. It must be prepared for presentation by intensive and carefully 'blue-printed' procedure, utilizing a minimum of time.
3. It must be built on the principle of demonstration and practice of 'learning by doing,' rather than on theory.
4. The program should provide for 'multipliers' to spread the training by coaching selected men as trainers who, after being qualified in an institute...pass the program on to supervisors and their assistance who would use it in training men and women workers (32)

These features express an understanding of the specific communication situation. Kress and Van Leeuwen observe that communication occurs only when both articulation and interpretation occur (7). When the audience of a message cannot understand what is articulated, communication fails. The principles above express the design, production, and distribution dynamics of the training that is encouraged: Item number 3 articulates design (demonstration and practice), and item number 4 offers suggested production and distribution dynamics: multiplier effect by trained supervisors. This training emphasizes visual, aural and physical (through practice) modes. These attributes are also included in multiple levels of training at the Arsenal.

Induction and Vestibule Training

The Visual

According to its 1942-1943 Summary of Operations, the training programs offered at the Arsenal used multiple modes of representation. Principally, they relied on visual modes, though manuals were distributed to employees. Even these manuals included photographs showing some dynamics of the work. Mayer observes that multimodal presentation is most effective when low-knowledge learners (those with little previous experience with or knowledge about the task) and/or high-spatial learners (those who have the ability to process spatial information quickly, also visual learners) are involved (161). For fuze and detonator processes, the Arsenal's 1944 History of Operations History of Operations acknowledges that, "training was concentrated upon two principal centers of activity:

1. Employee training, which included an induction talk to all employees and pre-employment or vestibule training, lasting two or three days, for fuze and detonator line operators, and
2. Supervisory training, which included instruction on how to teach a job, management principles in regard to human relations, and later, instruction on how to improve the method of doing the job" (104.)

The induction talk was given by the employment interviewer. "Induction talks were given to over 19,000 employees from December, 1941 until April 1942" (110). Vestibule training is a form of training that integrates classroom instruction and practice of on-the-job activities. The training includes mimicking actual practices.

■ ■ ■

The Fuze and Booster production lines showed a need for vestibule training of operators as these were fairly complicated assembly operations, some of which involved loaded component parts. It was especially necessary during the period in early 1942 when 25 to 50 new employees were being added daily.

At first, movies showing the loading and assembly of M-48 fuzes, anti-aircraft shells, etc. were shown after working hours to the inter-viewers and other personnel connected with employment. The M-48 fuze film was then shown to new employees going to work on the fuze lines. The procedure was to give the Induction and Safety Talks to all new employees at 8:30 a.m. and then take them, with the exception of the fuze line employees, to another area to be fitted for uniforms and safety shoes. The fuze line employees remained in the Conference Room for the movie on "Loading and Assembly of the M-48 Fuze." When the movie was finished, these employees had their lunch after which they also were taken out to be fitted for uniforms and powder shoes. As the M-48 picture was a silent film, a narrative was prepared explaining the various scenes.

Figure 1

Visuals were also combined with narration. As seen in Figure 1 (taken from page 110) vestibule training included the showing of silent movies that were accompanied by narration:

Mayer acknowledges that it is important to present both pictures and words simultaneously rather than in succession. Presenting them simultaneously enables the learner "to hold mental representations of both in working memory" (96). According to Allan Baddeley's model in *Working Memory* there is a phonological (auditory) channel and a 'visuo-spatial' (visual) channel associated with short-term memory. Schnotz suggests that when a visual image is presented to a reader, the reader can create a visual model as he/she listens to a narrative about the picture. If only text is used, the reader is forced to process the words while also trying to develop a mental model of the concept or activity. This creates an overload in working memory and compromises ability to learn (54-55). By facilitating use of both channels, people can better process information than they can when too much of one system is used.

Demonstrations by trainers as well as practice helped to facilitate further knowledge of the job. Workers were given "opportunities to perform their tasks under simulated operating conditions" (111) as practice after demonstrations.

Figure 2

From: Army Service Forces, Office of the Chief of Ordnance, Office of the Field Director of Ammunition Plants *Standard Practice Manual* 250 LB. Bomb, G.P., AN-M57A1 500 LB. Bomb, G.P., AN-M64A1 1000 LB. Bomb, G.P., AN-M65A1 2000 LB. Bomb, G.P., AN-M66A1 Tritonal Loaded

OPERATION VI-B - PELLET MANUFACTURE

PERSONNEL PER SHIFT

Production
Standard Crew

EQUIPMENT, TOOLS AND GAGES

Transfer tub or "stork", cooling pans, breaking table with screen, mallets, pellet boxes, dust collection box.

MATERIAL

Tritonal form V (slightly thinner than regular bomb pour).

SAFETY

1. Maintain good housekeeping.
2. Observe general safety rules for handling explosives.
3. Avoid splashes and overflows.
4. Operators should wear protective equipment.
5. Use non-sparking tools.

QUALITY

1. Check samples of pellets for density and absence of cavitation.
2. Check for excessive segregation.
3. See that pellets of proper size are produced.
4. Make certain pellets are properly screened, removing excess dust and fines.

METHOD

1. Receive Tritonal from Operation V in transfer tubs or "storks".
2. Pour into pans, not thicker than one inch.
3. Allow to stand undisturbed until completely solidified.
4. Remove from pans and place on breaking table. Break into proper sized pellets. The size of the pellets will vary with the size of the bomb being manufactured.
5. Screen dust from pellets and place pellets in boxes for future use.
6. Collect fines for use in Dopp Kettle (Operation V-5) or in Operation VII-8.

Figure 2

Manuals

Manuals were used primarily as reference materials, though once workers completed training, they were very familiar with their job. Generally, these manuals integrated text and graphics. While the SOP for howitzer shells separated textual information from pictures, the SOP for bomb-production integrated the two more closely with each other.

Figure 2 shows the SOP step for the pouring and breaking of tritonal, which would eventually be loaded into the tail of a bomb. Note that text and pictures are integrated into a single spread. This is an example of what Mayer acknowledges as showing text and image together.

The SOP integrates pictures on the verso page of textual information. Further, the nature of the textual information—Personnel, Equipment, Materials, Safety, Quality and Method—are separated but shown on a single page. The user can read the ordered textual information and look at the photograph alternately, approaching the simultaneous dynamic espoused by Schnotz and Baddeley above.

One may assume that the entire operation may not be effectively represented textually or through pictures or a combination. In *Following Instructions*, Ronald Amerine and Jeff Bilmes state that instructions may assume a certain embodied knowledge possessed by the user. While information is not explicitly represented textually or graphically, certain attributes of the operation may be implied (327). The opportunities to practice tasks after demonstrations offered employees embodied knowledge.

Manuals constitute a different combination of strata from that of the demonstrations. Print-linguistic and visual modes are used in tandem; however, it is clear that the manuals are portable tools to reinforce or help remind employees of practices they learned in the demonstrational/aural training.

Supervisor Training

Visual modes of representation were emphasized not only in training the lower level workers, but also supervisors. Because demand for munitions workers exhausted the existing number of trained workers, the government recognized that they would need to train new supervisors. TWI had a program in place for such training that revolved around addressing what it identified as five particular needs of supervisors. These are identified in Figure 3.

EVERY SUPERVISOR HAS FIVE NEEDS

1. *Knowledge of the Work*—materials, tools, processes, operations, products and how they are made and used.
2. *Knowledge of Responsibilities*—policies, agreements, rules, regulations, schedules, interdepartmental relationships.

These two knowledge needs must be met currently and locally by each plant or company.

Such knowledge must be provided if each supervisor is to know his job and is to have a clear understanding of his authority and responsibilities as part of management.

3. *Skill in Instructing*—increasing production by helping supervisors to develop a well trained work force which will get into production quicker; have less scrap, rework and rejects, fewer accidents, and less tool and equipment damage.
4. *Skill in Improving Methods*—utilizing materials, machines and manpower more effectively by having supervisors study each operation in order to eliminate, combine, rearrange and simplify details of the job.
5. *Skill in Leading*—increasing production by helping supervisors to improve their understanding of individuals, their ability to size up situations, and their ways of working with people.

Figure 3

Relative to item number 1: “knowledge of the work,” supervisors at the Arsenal were given a manual titled “Ammunition, General.” This document identifies all of the different munitions manufactured and their storage as well as safety issues related to each.

Supervisor training lasted eight weeks; and, while most of the instruction portion included explanation of visual diagrams and demonstrations of production procedures, half of it (144 hours) involved field work. Supervisors would have worked with the Ammunition, General—a manual that identifies the various munitions. Figure 4 shows a sample spread showing textual description and accompanying pictures.

General

Incendiary Various shades of blue

Tracer Various shades of red, such as orange and maroon, and white

Frangible White tip with green annulus to the rear

(4) Pyrotechnics are not marked in accordance with the general color scheme but, where color markings are used, they indicate the color of the pyrotechnic effect produced. In general, however, pyrotechnics are painted gray with marking in black. If the body of the item is aluminum or magnesium, it may not be painted. If the item is intended for incendiary purposes, markings are in purple.

h. **Marking.** The marking stenciled or stamped on the ammunition and on its packing container includes all information necessary for complete identification. Further information concerning painting and marking will be found under the specific type of ammunition in chapter 2 and in section IV of chapter 3.

8. CHADING.

a. Ammunition is manufactured to rigorous specifications and is thoroughly inspected before acceptance. Ammunition in storage is periodically inspected and tested in accordance with specific instructions furnished by the Chief of Ordnance.

b. Each lot of small-arms ammunition is graded primarily on the qualities which make that lot especially suitable for use in a particular class of small-arms weapons such as aircraft and anti-aircraft machine guns, rifles, and ground machine guns (WD SB 9-AMM 4).

c. Each lot of ammunition other than small-arms ammunition is graded as a result of surveillance tests into one of four grades, depending on its serviceability (WD SB 9-AMM 1).

General

BALL

INCENDIARY

HIGH-PRESSURE TEST

INCENDIARY, CAL. .50
M21 (728)

ARMOR-PIERCING

ARMOR-PIERCING
INCENDIARY, T49

ARMOR-PIERCING
INCENDIARY, M8

TRACER, M17

ARMOR-PIERCING
INCENDIARY, TRACER

TRACER, M10, T10, T43

FRANGIBLE

TRACER, M1, M16, T30, M21

Figure 1 - Color Identification of Small-arms Ammunition Types

Figure 4
Ammunition General, TM 9-1900 War Department Technical Manual, 1945

According to the Historical Summary, October 1941-December 1942, as part of their orientation, supervisors toured the entire facility (274). Such an orientation provides a visual understanding of how the different operations are situated in the facility. Another feature was the use of miniature models in the training for storage, loading and blocking of ammunition (270). This represents another visual mode to facilitate an understanding of spatial relationships associated with the processes.

Relative to the time spent in field work, the SOO from 1942 explains that “it was felt that this was a minimum in which they could absorb, through actual handling, sufficient knowledge of the methods and procedures involved in handling the enlarged variety of ammunition now in use” (267).

Describing further the nature of visual representations used, the same document acknowledges that:

Demonstrations as to the proper method of storing ammunition in magazines and of loading and blocking it in railroad cars were given by the instructors. In order to carry out these demonstrations miniature models of igloos, railroad cars, and several types of ammunition were designed and constructed to scale, thus making it possible to follow the specifications as given on the loading and storage charts. After the demonstrations had been completed, students were given ample opportunity to inspect and, later, to practice with the miniatures. (270)

Also, storage charts were made available to and studied by trainees prior their going on to field work (273). Clearly, the various modes worked to reinforce the information conveyed in each, while also facilitating practice with the equipment before actually handling explosive materials.

This approach, which emphasizes experiential and visual literacy skills in the workplace, assimilates that of the major employer in the Trackton case presented by Shirley Brice Heath in *Ways with Words*, wherein managers completed most of the application and work-related forms for mill workers who were generally low-literate. Heath acknowledges the application process that “(t)he employee is asked only to sign the application” (233). The employers, in Heath’s study, adjusted their literacy expectations to account for the low literacy levels of their employees. Workplaces can accommodate varied literacy levels by relying on oral, visual, and on-the-job instruction.

The New London Group actually espouses use of visual modes of communication to help people of diverse backgrounds understand each other better. They write that, “we want to extend the idea and scope of literacy pedagogy to account for the context of our culturally and linguistically diverse and increasingly globalized societies” (61). Furthermore, they state that, “[i]n some cultural contexts...the visual mode of representation may be much more powerful and closely related to language than ‘mere literacy’ would ever be able to allow” (64). Relative to the context and purpose of worker training—helping workers to be able to perform a given task—a visual model of training enables several workers to be trained with the same information in a situated setting, and it eliminates potential misunderstandings among workers and the employer by facilitating interaction and immediate clarification of

information. Mayer also observes that it is better to present words orally (oral narration) rather than as printed text when incorporating visual images with the message. Using auditory as well as visual channels helps learners manage the information better (134). It also reinforces what Arnheim observes about the power of the visual.

According to Arnheim, people process an entire image in context and having to break an image down into text forces one to divide the various parts. He states, “The mind visualizes the whole image, whereas text must piece the image together through a linear process” (249). Drawing a diagram is easier to do than to try to describe a process or new tool through words alone.

DISCUSSION

The modes used for training at the Arsenal that were associated with the TWI philosophy were affected by a number of dynamics. These included: the varied literate background of employees; the war-time economic environment that shifted needed labor skills from farming to war industry, and efficiencies needed to quickly prepare workers to do their work. Within this socio-political environment, employers recognized a need to breakdown tasks so that employees could be quickly trained, and they relied on visual and experiential learning approaches to reduce potential problems associated with varying literacy levels of their employees. They were concerned with the immediate war cause; not with long- term literacy learning.

Relative to work training at the Arsenal, the government espoused training that minimized potential literate differences among workers and created efficiency in training by emphasizing instruction that integrated visuals as well as demonstrations and opportunities to practice the skills shown. Because employees came from varied literate backgrounds, Arsenal operators understood that there would be a need to accommodate related literate differences. While manuals were distributed, these were used only as reference guides in case someone forgot a specific task. However, they integrated many pictures to help readers visualize the task. Mayer identifies two metaphors of multi-media learning; information acquisition, which facilitates adding information to one’s existing knowledge; and knowledge-construction, which applies to model building to facilitate cognitive guidance (14). Training at the Arsenal focused on specific task-oriented information acquisition, disregarding the knowledge-construction modeling metaphor. The emphasis was on training for a specific task as quickly as possible.

Again, as the New London Group asserts, “the visual mode of representation may be much more powerful and closely related to language than ‘mere literacy’ would ever be able to allow” (64). By emphasizing the visual skills of workers the government and employers connected to the Arsenal effectively minimized literate differences among workers, helping people from various backgrounds understand how to perform their specific tasks.

Because of the war-time economic environment, the operators of the Arsenal needed an efficient way to prepare workers for their tasks. Many migrants had skills training for farm work, but they would need retraining for

war-related industry. Training that emphasized the visual could accommodate faster transition in skills. This is further reinforced by the transient nature of the migrants. With a high turnover, employees needed to be able to be hired and placed to work quickly.

Employees were exposed to multiple modes of representation in an effort to facilitate efficient, rote learning and each mode reinforced other modes. This aggregation has implications for employees. As shown in the SOP for the tritonal bomb, what is represented within each step is coded: there are pictures and text on opposite pages. Further, the text is divided into three unique attributes of the task. The space that is used for text is able to be redefined because of the division of labor to simpler tasks. Kress and Van Leeuwen observe that “it is important at points like these to be able to tell apart the actual causes and motivations for aggregations and disaggregations from ideologically motivated one” (123). A similar representation is used for the supervisor training manual, facilitating movement from one level to the next. The modes are aggregated similarly at the levels of line worker and supervisor. However, other levels required more writing and reading skills, as suggested by the summary reports themselves. So, employees could rise only so high in the organization before being negatively affected by disaggregation of modes.

IMPLICATIONS

The current global economy encourages workplaces to relocate jobs to different parts of the world. Multimodal forms of training facilitate learning in such environments. Workplaces also want employees to be able to transition quickly into their job without needing much training. However, short term decisions employers make about how to increase efficiencies can carry long term consequences.

The Training within Industry model is still practiced, and an annual conference about the impact that it has had on companies is held. Further, recent publications such as *Toyota Talent* (2007), *TWI Workbook* (2006) and *Training within Industry: the Foundation of Lean* (2005) espouse TWI as a training model. Such attention to modes used in training practices should include critical examination of political, cultural and economic implications.

Mitchell called attention to the increasingly global visual culture that includes flight simulators and computer-aided design tools and virtual environments in the workplace (23). Also, recently, forms of training are being conducted via video gaming environments. A point Gee makes about games and their ability to help people learn is that they need to be able to be learned. That is, learners need to be able to understand the game itself before they can use it for learning (6). People need to have a certain kind of visual literacy in order to use games for learning (13). Gee acknowledges that game environments represent a different “semiotic domain” than other, more commonly experienced semiotic domains. Gee espouses using video games for learning activities because of the social dimensions involved in such games, and their increasing popularity suggests that many people may be literate in

their use. Games also, however, teach critical thinking by encouraging users to evaluate their experiences and apply that learning to new encounters (92). So, there are cognitive benefits to recent forms of multimodal forms of training beyond learning a single task; however, there are also negative implications with an over-emphasis on the visual and de-emphasis on reading and writing skills. Brandt observes that while literacy standards have changed over time, there are still social and economic repercussions associated with print-text literacies; she writes, “[t]he ability to read and, more recently, to write often helps to catapult individuals into higher economic brackets and social privilege” (2).

As evidenced with the examples of print materials provided here, line workers practiced predominantly visual and aural/oral literate skills, while supervisors experienced a balance between the visual and the verbal forms of representation. Finally, the higher-level administrators, who wrote the annual summaries

Understanding factors that may affect worker training and the relationship between the visual and the textual modes of representation relative to a given context will help employers to develop appropriate training materials in such contexts while encouraging employees to advance their literacy skills.

of operations, emphasized print-linguistic skills. These differences in modes across the levels within the organization represent a form of social stratification. Workers who do not have certain literate skills cannot advance beyond a given level, creating a literacy-oriented barrier to advancement. If literate practices across modes of representation are practiced such that all experience and learn how to practice them with proficiency, that barrier is eliminated.

Workers are able to learn tasks more quickly when training integrates multimodal forms of representation. Understanding factors that may affect worker training and the relationship between the visual and the textual modes of representation relative to a given context will help employers to develop appropriate training materials in such contexts while encouraging employees to advance their literacy skills. As such, this study will contribute to an understanding of how workers' literate backgrounds affect their ability to learn certain skills and how modes used in training practices can accommodate certain literate backgrounds and experiences of new employees toward a more diversely literate workforce. Further, this study advances Kress and Van Leeuwen's assertion about socio-political causes that effect aggregations and disaggregations of modes by calling attention to evidence of the reason that certain modes were used in this training. Further study of such implications can also include socio-economic implications by looking at historical ethnographies of workers and their families in the particular areas

where they lived. These ethnographies can include locales from which or to which auto manufacturers have relocated.

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NOTE

Boomtown Arsenal is a pseudonym for the actual worksite.

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