Development of a Hybrid Curriculum for Acquiring a Technical Competency

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Packaging equipment for shipping and storage is a key logistics technical competency. The requisite knowledge and skills are taught using a curriculum consisting of related courses and instructional materials on preservation, packing, and marking. As a result of the Department of Defense Base Realignment and Closure (BRAC) initiative, the responsibility for administering the Defense Packaging Curriculum, along with classroom materials, training aids and shop equipment, was transferred from the US Army School of Military Packaging Technology (SMPT) to the US Defense Ammunition Center (DAC). DAC assembled an interdisciplinary development team whose goals were: (1) to consolidate and update the legacy SMPT courses into a unified and coherent curriculum, (2) to identify a unique set of curriculum learning objectives, and (3) to identify an optimal mix of instructional strategies. The team developed a hybrid curriculum that combines an online basic course for off-site study with advanced resident instruction at DAC. The resident instruction systematically extends the use of real-life examples introduced in the online course, and tightly integrates classroom lectures with hands-on practical exercises in a shop environment. The approach uses real-life scenarios and common multimedia across the curriculum elements to promote continuity, cognitive momentum, and training efficiency. We discuss how the team achieved their goals and relate the findings to hybrid curriculum development efforts. We also discuss products and practices developed and lessons learned of value to the education and training communities.

ABOUT THE AUTHORS

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Tracy is a Senior Instructional Designer in the Learning and Human Capital Business Unit of Serco, Inc. in Oklahoma City, OK. He has a Master of Education specifically addressing the principals of instructional design and the associated psychology and technology. He has five years experience in all phases of the instructional systems design model and nine years experience as an instructor. Tracy has extensive knowledge of computer aided instruction and programs that facilitate human interaction to include the development of over 150 animations and tools. Tracy is currently the lead designer of the Defense Ammunition Center Military Packaging web based course.

Doug is the DAC Packaging Technology Program Manager. He is responsible for effecting the transition to DAC and implementing the curriculum design modifications. He is a doctoral candidate at Nova Southeastern University where he is completing his dissertation on the effectiveness of distance learning methodologies in an adult learning environment. He has an MS in Administration from Central Michigan University. Doug retired from the U.S. Navy after 22 years of active service and has over 30 years of logistical experience and over 12 years of experience as an adult educator and curriculum developer.

Dave is a Logistics Management Specialist, Lead Instructor and co-developer for the Defense Ammunition Center Technical Packaging School curriculum. He has 5 years experience as an Instructor for the Defense Ammunition Center. Dave was a Quality Assurance Specialist Ammunition Surveillance specialist for the Department of the Army prior to becoming an Instructor. He received his Bachelor's Degree in Music in 1988 with Honors and holds an Associate of Applied Science Degree in Business Computer Systems from Peninsula College.

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INTRODUCTION

A Hypothetical Scenario

Lt. Col. Hawthorne,

Yesterday we received a shipment from Ft. Hendrix Supply Depot. Every item in the shipment arrived in unusable condition. I don't know if it was due to poor handling or if they were not packaged correctly. This has caused a major delay in completing our mission. I have attached several pictures of the damaged items. I hope you are able to make sure this doesn't happen again. Fortunately, we were able get some old parts repaired but not in time for mission go. I am sure you will be looking into possible causes of this problem. Let me know if I can be of assistance.

Col. Brewster, Commander
3rd Battalion, 106th Infantry
Bagram, Afghanistan

Background

As can be seen in this hypothetical scenario, packaging equipment for shipping and storage is a key logistics technical competency and a critical enabler for mission success. In 1948, the Army Chief of Ordinance requested that the Automobile Manufacturers Association conduct a study on Military Packaging. The study recommended that the military develop a program to provide standardized training for the Department of Defense (DOD) packaging function.

In 1951, the Joint Military Packaging Training Course was established to provide training developed jointly by the military and private industry, and the Joint Military Packaging Training Center (JMPTC) was created. The JMPTC, which is located at Aberdeen Proving Ground, MD, eventually changed its name to the School of Military Packaging Technology (SMPT). The SMPT was given the responsibility for administering the Military Packaging program, which is co-sponsored and approved by the National Institute of Packaging, Handling and Logistics Engineers.

The Joint Military Packaging Training Course evolved into a curriculum, hereafter referred to as the "legacy curriculum." The legacy curriculum consisted of a collection of related packing, preservation, and marking courses. Individuals who successfully complete the curriculum were awarded a certificate and were eligible to apply for a professional designation.

The courses that comprised the curriculum provided instruction and training in the content areas of cleaning, packing, preservation, and marking, and were intended for differing audiences. The curriculum consisted of four classroom courses and two correspondence courses. Additionally a course on marking and labeling packaged materials was also included. The identification (ID), title, training presentation method, and length of the legacy courses are shown in Table 1.

Table 1. Legacy Packaging Technology Curriculum

ID	Title	Method	Length
F-13	Basic Preservation and Packing	Class.	2 Weeks
F-13C	Basic Preservation and Packing	Corres.	N/A
F-1	Preservation and Intermediate Protection	Class.	2 Weeks
F-2	Packing and Unitization	Class.	2 Weeks
F-16C	Packaging Design	Corres.	N/A
PT3200	Marking for Shipment and Storage	Corres.	N/A

Note: ID = Course Identification
Class. = Classroom
Corres. = Correspondence

As part of the DOD Base Realignment and Closure (BRAC) initiative, the Defense Ammunition Center (DAC) Training Directorate in McAlester, OK was given the responsibility for the military packaging curriculum from the SMPT in October 2008. The DAC Training Directorate has the responsibility for delivering Packaging Technology courses to individuals in all branches of the active military and

reserve components, the Army (the primary user), the Air Force National Guard, and DAC interns. The SMPT legacy courses were presented quarterly to relatively small classes (i.e., less than 10 students). Due to scheduling uncertainties and available resource requirements within the DOD, the instructors typically had little advanced knowledge of the number and identity of attendees prior to the start of the class.

REQUIREMENTS

DAC had two primary requirements for the revised curriculum. First, the courses within the legacy curriculum needed to be reviewed in order to consolidate content and objectives and to eliminate areas of overlap. Second, recommendations were needed for selecting or updating training strategies based on the learning objectives, target audiences, available technology, and desired training outcomes. Accordingly, the purpose of the effort described in this paper was to develop an efficient and effective curriculum that leverages appropriate instructional strategies for achieving the objectives. In order to focus on curriculum level instructional issues and provide curriculum level recommendations, the project targeted the entire Packaging Technology curriculum, and not simply the individual courses and instructional events.

In the remainder of the paper we summarize the findings of our front end analysis (FEA), describe the hybrid curriculum we developed, discuss challenges we encountered, highlight key features of the curriculum, and discuss the next steps.

FRONT END ANALYSIS

Goals

The team performed an FEA on the legacy curriculum that produced recommendations for maximizing training effectiveness, consistency, and flexibility. To this end, the team gathered information about the intended curriculum structure, scope, and environment by performing the following activities:

- identifying the target audiences
- considering instructional strategies
- examining documentation on the content areas
- participating in a two-week course on Defense Basic Preservation and Packaging taught at the DAC training facilities
- interviewing the DAC instructors to understand their vision, goals, and plans for the overall curriculum
- interviewing students to understand what they feel is important.

Target Audience and Instructional Strategies

The target audience for the training includes members of all branches of active military, the National Guard, DOD civilians, foreign military, and contractors. The diverse instructional strategies considered included asynchronous web based training (WBT), self-study, classroom instruction, and practical exercises (PEs) conducted in a shop environment. The overall curriculum goal is to help improve supply management and assure material readiness in a timely and cost effective manner.

Key Success Factors

Before the team could make recommendations, it was considered important to clearly understand the key success factors of the current training methodology. Accordingly, the following factors were identified as key contributors:

- A collaborative learning environment, including experienced returning students, new students, and the instructors
- Emphasis upon development of higher-order thinking and decision-making skills through feedback during discussions and PEs
- Regular interaction with required source materials, regulations, mockups, and shop equipment
- Student completion of graded assessments with timely feedback from the instructors.

The team conducted several activities, which are discussed more detail in the paragraphs that follow:

- Review of the legacy curriculum and revised DAC curriculum materials
- Analysis of the shop environment and PEs
- Audit of the classroom and shop presentation materials
- Informal interviews with the instructors
- In-person observance of the class and shop activities as taught and supervised by DAC.

At the onset of the project the team decided that the instructors should teach one iteration of the basic course prior to developing the WBT. The instructors taught the basic course for the first time at the DAC facilities in McAlester, OK in September 2009. At that time, the course was the only course in the curriculum taught as residential instruction. The residential instruction portion of the curriculum

included 80 hours of instructor-led classroom training consisting of:

- 33% lecture supported by custom PowerPoint presentations
- 53% demonstrations and PEs
- 14% evaluation (two exams and one practical exercise).

Training Site Selection

Mastering the content and acquiring the skills in the curriculum require a certain amount of student hands-on, tactile interaction with current cleaning, preservation, packing, marking, and labeling equipment. Therefore, with the exclusion of the packaging design course, a decision was made to teach the courses comprising the legacy F-13 and F- 13C curriculum at the DAC training facilities.

Reusing Related Material from Existing Courses

DAC is responsible for teaching a wide variety of courses related to ammunition operations, safety, and logistics. Some of these courses (e.g., Transportation of Hazardous Materials) contained learning objects and media assets directly related to the Packaging Technology curriculum. The team identified these similarities, explored their applicability, and included the learning objects and assets as appropriate. The residential portion of the curriculum includes 1) a classroom learning environment, 2) emphasis on knowledge application and procedural tasks, and 3) motivation through real-life scenarios. A major task of the FEA was to investigate different instructional strategies suitable for the courses comprising the curriculum, identify those strategies that enable accomplishment of the course and curriculum learning objectives in a timely and efficient manner, and make recommendations for their implementation.

Training Issues

The team systematically reviewed documentation from each of the legacy curriculum courses listed in Table 1 to identify relevant training issues. These included:

- Terminal Learning Objectives (TLOs) and Learning Objectives (ELOs)
- How the TLOs/ELOs mapped to Bloom's Revised Taxonomy levels (Anderson et al, 2001)
- Tasks/activities, standards, and performance conditions
- Required resource materials and reference documents.

Learning Objectives

Developing a list of unique and comprehensive LOs for the Packaging Technology curriculum was a major prerequisite for the success of this effort. Identifying the TLOs and ELOs from the legacy curriculum (as well as from other training and job performance documentation) and mapping them to the appropriate taxonomy level, enabled the team to identify an initial mix of instructional strategies (e.g., instructor-led classroom training, web-based training). The strategies were based on the type of cognitive process required to meet each LO.

For example, WBT and distance learning (DL) have generally been found to be more effective for meeting LOs classified in the first two levels of the revised taxonomy (i.e., remembering and understanding). In comparison, instructor-led and hands-on training have generally been found to be more effective for training the higher order cognitive skills (i.e., applying and analyzing).

Following the classification of the LOs, the team reviewed legacy material from each of the courses (e.g., presentation slides, student study guides, reference documents) to identify areas of duplication, unnecessary redundancies, similarities, or content overlap. Identification of the overlap in objectives or content between two or more of the courses was critical for facilitating the development of an integrated and streamlined course and curriculum scope.

The team constructed a matrix that mapped the curriculum learning objectives to the legacy courses listed in Table 1. These data were very helpful for determining in which courses the curriculum LOs were covered, as well as the extent of overlap. For example, the learning objective "Perform cleaning and drying processes appropriate for an item" is currently covered in the basic course; however it is also covered in the advanced course, albeit at a more detailed and comprehensive level.

DEVELOPMENT CHALLENGES

Many challenges for developing the Packaging Technology curriculum were identified from the FEA. We discuss these challenges in this section.

Logistic Burden

As noted previously, the Packaging Technology curriculum is an acquired curriculum. Students who previously attended SMPT will now travel to DAC

for instruction. Besides the course instructors, many other DAC personnel will be involved in the preparation of this training. The direct costs associated exceed the financial burdens associated with other training methodologies. The curriculum costs include:

- Staffing and facility costs for the DAC training site
- Restructuring of DAC facilities to accommodate the course requirements
- Travel costs for a rapidly growing and geographically dispersed training audience
- Material printing and reproduction costs
- Productivity impacts to home organizations during the student's absence

Instructor Preparation

Shop equipment and training aids that support the curriculum were transferred from SMPT to DAC. The instructors assigned to this course organized, analyzed, and assimilated the equipment and aids as much as possible while preparing to teach an initial version of the basic course. As predicted, many problems arose concerning outdated references and procedures. These problems were corrected on the spot (if possible) or recorded for later tasking.

Audience Dichotomy

Courses comprising the curriculum are attended by both initial certification students and those seeking recertification. While the range of tasks may vary across the diverse audiences who are required to attend the training, many students gain certification in order to perform their jobs more accurately or to perform their jobs in an official capacity.

Consistency of the Learning Opportunity

As stated earlier, the inherited curriculum is in need of an overhaul. As the instructors teach more iterations of the class, it is expected that they will be identifying more parts that need updating. Whether it is an old reference or an outdated process, these elements will need to be rectified in order for the course to become consistent over multiple classes.

Shop Noise

The Packaging Technology shop is located in a large warehouse-type building. It has been remodeled to accommodate the large shop equipment. The warehouse also houses the DAC Training Directorate printing department, which uses an industrial size printer and several other machines associated with binding books. The printing noise and shop equipment combined with the large space can result in communication difficulties.

On-The-Spot Information Access

Currently, the classroom is located in a different building than the shop. Students have to walk back and forth depending on the day's class schedule. Accordingly, access to any information presented in the classroom may be a problem. As students proceed through a shop exercise, they must rely on memory, notes (if taken), reference material, or another student within their shop group for help.

Relevancy, Accuracy and Newness of Media

The acquired curriculum is dated 2002. This is the approved date, which may mean the last time it was closely examined was eight years ago. During this time, many of the references have likely changed. In addition, there are many acquired videos associated with courses within the curriculum. Many of the videos needed updating to reflect the latest processes or simply to reflect a cleaner, more modern look. Many of the images associated with the written courses needed to be redeveloped. With the latest digital technologies, there are many more options to consider besides static images, such as animations.

Fluidity of Source Materials

At first glance the courses acquired from SMPT appeared to be scoped fairly well. The major topics of each section of the courses are sometimes long or vague and several have only a few words of explanation. After observing the basic course and reviewing the scope as laid out by the instructors, many of these topics appeared to the team to become much more manageable and better organized.

COMPONENTS OF THE HYBRID CURRICULUM

Based on the findings from the FEA, the team recommended a hybrid (blended) curriculum that combined several instructional strategies as illustrated in Figure 1. The particular combination of the strategies was based in part a mapping between the six levels of Bloom's revised Taxonomy of Educational Objectives (Anderson et al., 2001) to the components of the proposed training strategy mix (see Table 2). A brief description of each component is provided below.

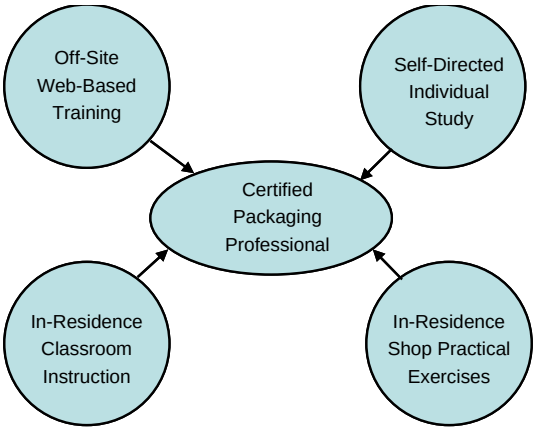

Figure 1. Hybrid Curriculum Components

Basic Preservation and Packaging WBT Course

The WBT course was designed as an orientation to, and overview of, the entire Packaging Technology curriculum. The aim was to provide students with the opportunity to acquire basic knowledge prior to arriving at the DAC training facilities, thus allowing the instructors to use the classroom and shop time more efficiently. The course was renamed PACK1ADL.

Course Structure

Based on instructor experience, existing technical documentation, and discussions among the team members, the WBT Course was organized into the 23 modules listed in Table 3. The modules names corresponded to the major topics in MIL-STD 2073-1 *Standard Practice for Military Packaging*. Table 3 also provides an example of an LO within each module.

Scenario-based Learning

There was considerable discussion about the elements of the PACK1A course and the desire to approach the development process differently than DAC had done before with other WBT courses. A major concern was how to promote interactivity, especially since the bulk of objectives dealt with declarative knowledge. The team finally settled on the idea of the learner being a newly hired Director of Logistics for a packaging department at a fictitious military base. The first order of business is to attend a department meeting with the base commander where the learner finds out that a shipment from their department reached its destination in poor condition. The learner is given a report on the shipment along with a blank document that they must fill out as they progress through the course.

Table 2. Mapping of Training Strategies to the Revised Bloom's Taxonomy

Taxonomy Level	Example of Learning Object	Training Strategies
Knowledge	Identify the limitations of a solvent for removing corrosion.	ILT Shop DL
Comprehension	Decide which preservation method should be used for a ferrous machine part.	ILT Shop DL
Application	Fabricate a triple-wall corrugated box.	ILT Shop PEs
Analysis	Select the correct preservation method for a non-ferrous part.	ILT Shop PEs
Synthesis	Select the best combination of cushioning, blocking, and bracing for packing an ammunition item.	ILT Shop PEs
Evaluation	Determine if a marking code for an electronic circuit board is correct.	ILT Shop PEs

Note: ILT = Instructor-led Training
DL = Distance Learning
PE = Practical Exercise

To help the learner fill out the document properly, two packaging experts, "Bill" and "Jennifer", have been requested by the base commander. They guide the learner through all the packaging processes and explain each part in detail. (See Figure 2).

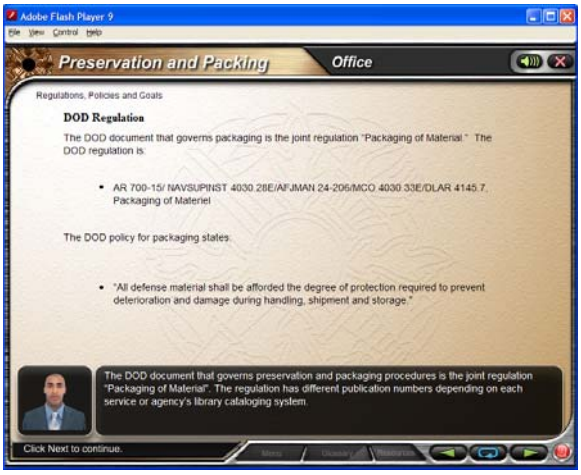

Figure 2. Screenshot from the WBT Showing Expert "Bill" Explaining DOD Packaging Regulations

Table 3. PACKADL: Basic Packaging and Preservation Modules

Number	Module Title	Example of Learning Objective
1	Introduction to Military Preservation	Identify the basic steps of preservation.
2	Safety Guidelines for the Course	Describe the safety practices and procedures necessary in a packaging environment.
3	Corrosion Control	Identify the six types of corrosion and procedures for prevention.
4	Cleaning and Drying	Describe the differences between military and commercial preservation requirements.
5	Preservatives and Preservative Application	Understand the differences between contact preservatives and preservation materials.
6	Electrostatic Discharge Control	Define electrostatic discharge.
7	Preservation Materials and Heat Sealing Equipment	Demonstrate selection and use of preservation barrier, wrap materials and equipment.
8	Military Methods of Preservation	Understand how to preserve materiel according to military preservation methods.
9	Marking and Labeling	Determine the proper marking for a unit or intermediate pack.
10	Return of Repairables	Describe protection required for repairable items and field returns.
11	Packaging Documentation	Understand the scope of MIL-STD-2073-1: *Standard Practice for Military Packaging*.
12	Introduction to Military Packaging	Identify packing cycle, including container selection based on load types, levels of protection, and the hazards associated with storage and protection.
13	Cushioning, Blocking and Bracing	Describe purpose, materials and methods of cushioning, blocking and bracing items inside package.
14	Fiberboard Boxes	Discuss the nature and fabrication of fiberboard boxes.
15	Triple Wall Fiberboard Boxes	Identify the packing, closing and reinforcement requirements of a triple-wall fiberboard box.
16	Wooden Boxes	Perform packing operations in accordance with ASTM and MIL-STD-2073-1.
17	Crates	Describe the design and use of crates in accordance with ASTM and MIL-STD-2073-1.
18	Weatherproofing the Pack	Describe methods of outer container weatherproofing in accordance with ASTM requirements and MIL-STD-2073-1.
19	Cargo Unitization	Apply cargo consolidation practices.
20	Outer Pack Marking	Apply markings and labels to outer packages and shipping containers.
21	Specialized Containers	Describe various specialized container requirement including fast packs, returnable and hazardous materials containers.
22	Small Parcel Shipments	Determine the essential features of small parcel shipments.
23	Environmental Considerations	Identify techniques and trends associated with the consumption of packaging materials and management of solid waste.

Bill and Jennifer are speaking characters (using text-to-speech technology) and the learner has the option of listening or turning them off and just reading their text. The experts choose three items from the damaged shipment for the learner to focus on: a head-up display, a fuel pump, and a computer circuit board. The form requests specific information for these three items.

The WBT course is divided into two parts: Preservation and Packing. Each part has a comprehensive test that must be completed with 90% correct in order to receive credit. Multiple attempts are allowed. At the completion of the PACK1A course, the learner is encouraged to print their report of the three items. This report will then be incorporated into the instructor-led follow-up course, PACK1B, to be held at the Defense Ammunition Center. In addition, the team incorporated several other interactive features (e.g., dragging and dropping screen objects, 3D animation.) to keep the learner engaged. In addition, a Resources page and a Glossary are always available.

Self-Directed Individual Study

At all points in the curriculum, the students are encouraged to engage in self-directed individual study. Written materials and internet-based resources are available to support the individual study portion of the curriculum.

In-Residence Classroom Instruction

Classroom instruction is provided using a lecture and demonstration format at the DAC training facilities. At the completion of the classroom instruction, the students are expected to understand and apply:

- methods and techniques of preservation to multiple types of items in preparation for packing
- methods and techniques of packing to multiple types of items
- packing procedures and operations involved in the shipping preparation of an item.

The classroom lectures are supported by a student study guide based on MIL-STD 2073-1, presentation slides, and in-class demonstrations using realistic models of preservation and packing materials. A screen shot from one of the Marking and Labeling Module classroom presentation slides is shown in Figure 3.

In-Residence Shop Practical Exercises

Shop PEs are conducted in a large converted warehouse building at the DAC training facilities. Students are assigned to work groups and are given demonstrations of various preservation, packing, marking, and construction techniques by the DAC instructors, and are then given the opportunity to practice these techniques under instructor supervision.

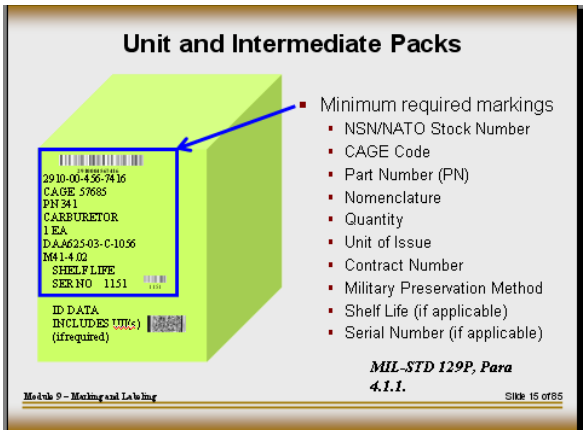

Figure 3. Screen Shot from a Marking and Labeling Module Presentation Slide

There are several workstations in the shop area dedicated to different processes and skills, such as cleaning, drying, and preserving corroded hardware items, fabricating cardboard and wooden boxes, applying markings and labels to boxes, packing electrical items prone to damage by electrostatic discharge (ESD), and testing the tensile strength of wrapping and banding materials (see Figure 4). DAC is planning to utilize mobile devices, such as digital picture frames, the Apple iPad tablet computer, or laptop computers to provide just-in-time training and point-of-performance job support. These are discussed further in a later section.

Figure 4. Student Fabricating a Box During a Shop Practical Exercise

KEY FEATURES OF THE HYBRID CURRICULUM

In this section we discuss three key features of the hybrid curriculum which make this effort noteworthy, and which are likely to be of interest the learning and performance support communities. These are: 1) the use of realistic work flow scenarios, 2) the use of common instructional and performance support videos repeated across the curriculum components, and 3) the promotion of continuity and cognitive momentum to facilitate learning and performance.

Realistic Workflow Scenarios

A key feature of the hybrid curriculum approach, discussed previously, is the use of a scenario-based learning strategy for to promote problem-based learning (Whelan, Mansour, and Farmer, 2002). As noted previously, the team developed a scenario in which several items were damaged during shipping because of improper preservation and packing practices. This set the stage for the students to continue working with the same damaged items during the in-residence classroom and shop portions of the curriculum.

Extensive Video Support

One of the key findings of the FEA was that meeting many of the LOs involved in the acquisition of packaging knowledge and skills (e.g., identifying appropriate packing materials, demonstrating a cleaning procedure, applying a label to a unitized package) could be facilitated by the expeditious use of video media. The videos are first encountered by the student in the self-paced WBT environment, and afterwards shown at the appropriate time and place during classroom and shop PEs to support specific on-the-spot learning or performance support needs.

Legacy Videos

The team obtained 24 digital video files, ranging from 12 to 19 minutes, from the SMPT legacy curriculum that covered key packaging topics, such as:

- Characteristics of Packaging Materials
- Preservation Techniques
- Electrostatic Discharge

The team systematically reviewed the collection of SMPT legacy videos to identify segments that were applicable to the curriculum LOs. Video segments, typically less than two minutes in duration, were extracted from the legacy video footage using video editing software. Table 4 lists examples of segments extracted from the legacy videos and the LOs to which they map. Figure 5 shows a screen shot from a segment extracted from the legacy video "Preservation Techniques."

Table 4. Examples of Legacy SMPT Videos Mapped to Curriculum Learning Objectives

Video Clip Name	Learning Objective
Determining palletized load pattern.	19.2 Identify the different types of palletized loads.
Components of a wooden crate	17.3 Describe the materials used in crate construction.
Marking and labeling methods	9.2 Determine the proper marking for a unit or intermediate pack.
Styles of packing boxes	16.6 Describe the classes, styles, and types of wooden boxes used for military packaging.

Figure 5. Screen Shot from a Legacy Video Segment Illustrating a Preservation Technique

Original Videos

There were some LOs that were not supported by video segments. Therefore, the team shot several original video segments at the DAC shop facilities to fill the gaps. For example, one of the objectives in the Cleaning and Drying Operations module was to operate a machine for using an abrasive blast process to remove corrosion from a piece of equipment. Figure 6 shows a screen shot from a video the team scripted, videotaped at the DAC site, edited, and narrated that shows one of the DAC instructors demonstrating the proper abrasive blast process.

Figure 6. Screen Shot from the Original Video "The Abrasive Blast Process"

Immersive "3D" Videos

In addition to segments extracted from the SMPT legacy videos and the original videos shot at DAC, the team created another group of videos that allowed the students to interact with an immersive 3D view of materials (e.g., polyurethane foam) or items (e.g., a corroded gear assembly).

The team used a high definition camcorder to capture a complete 360 degree rotation of several types of materials or items. The video files were converted to 1) an iPad compatible file and 2) a Flash file that allowed the student to manually rotate the material or item within the WBT. A screen shot from a 3D video showing a damaged head-up display (HUD) is shown in Figure 7.

Figure 7. Screen Shot from Damaged Head-Up Display Immersive"3D" Video

Like the legacy and original video segments discussed previously, the 3D video segments can be viewed 1) within the WBT, 2) during classroom instruction, and 3) on the shop video display stations. The video clips are organized in a video data base to facilitate their discovery and retrieval, and are available to the students during the shop PE on viewing devices such as a digital picture frame, a laptop computer, or an Apple iPad tablet computer (see Figure 8). These devices can be located at strategic places in the shop, in the general vicinity of the process or skill being learned or practiced for easy viewing.

A major advantage of using mobile devices in the shop training environment, such as the Apple iPad or iTouch, is that the students can become familiar and comfortable with their operation and capabilities, thus setting the stage for delivery of learning and performance content via mobile devices in the actual job environment. In fact, many, of the students who attended the in-residence training were already familiar with mobile technology.

Figure 8. Performance Support Video Displayed on an Apple iPad

Continuity and Cognitive Momentum

A third key feature in the Packaging Technology hybrid curriculum is the systematic use of common multimedia across the curriculum components to facilitate transitioning from one instructional strategy to another. In a hybrid or blended training curriculum, it is important to have continuity and smooth transitions between the diverse instructional strategies. Otherwise, the students may expend unnecessary mental effort in adapting to a different instructional strategy when shifting from one to another. One way to promote a smooth transition

and reduce student adaptive mental effort is to plan the curriculum structure and content to have a high degree of c*ognitive momentum* between the strategies.

Cognitive momentum (Gamble, 1986) is a concept that is analogous to the more frequently used concept of *visual momentum* in display system design. As described by Woods (1984), the amount of visual momentum supported by a display system is inversely proportional to the mental effort required to place a new display into the context of the total data base and the user's information needs. When visual momentum is *high*, there is continuity across successive views that support the rapid comprehension of new information. On the other hand, when visual momentum is *low*, the observer must expend excessive mental effort reorienting to each new view. An example of a design practice to increase visual momentum in a display system is placing a common element, such as a waypoint symbol, in a pilot's panel mounted display, head-up display, and head-mounted display.

Accordingly, it is reasonable to propose that the amount of cognitive momentum inherent in a hybrid instructional system is inversely proportional to the mental effort required for the student to place a different instructional strategy into the context of the total information system and the student's instructional needs. As is the case with visual momentum, when cognitive momentum is high, there should be good continuity across different instructional strategies and rapid and efficient comprehension of material following the transition to a different strategy.

We propose that the judicious use of common multimedia elements, such as images and videos, across different elements of the hybrid curriculum has the potential to promote cognitive momentum, and thereby increase training efficiency. This is an issue that should be investigated in the future by the learning and performance support communities.

CONCLUSION

Hybrid or blended learning has received a good deal of attention lately as an instructional strategy (e.g., Whelan, Mansour, and Farmer, 2002). However, much of the work in this area has focused on the course level rather than on the curriculum level. There are additional concerns and complexities at the curriculum level that need to be better understood to ensure effective learning and transfer of training.

In this paper we discussed a project to develop a learning objective driven, hybrid curriculum for acquiring a logistics technical competency, namely packaging equipment for shipping and storage. We focused on the key features of the hybrid curriculum that make this effort noteworthy. Our experiences during the development stage, including the processes, products, and outcomes, are likely to be of interest to members of the education and performance support communities, and in particular to those responsible for technical and vocational training. The next stage in this effort is to implement the hybrid curriculum and to evaluate its effectiveness.

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