Designing an EPSS for Military-Use Electronic Classrooms

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ABSTRACT

Technology should help learners transcend the limitations of their minds. When learners use technologies as partners, they can off-load unproductive tasks, and work more productively. The purpose of designing this EPSS was to assign cognitive responsibility to each part of the learning system that does it best. By implementing an EPSS, we allocate to the learner cognitive responsibility for recognizing, judging, and organizing patterns of information and allocate to technology responsibility for storing processes, procedures, and facilitating information retrieval. In this way, the learner, not the EPSS, determines the learning path by choosing what information is needed and when and how it's provided.

It has been observed that instructor performance using equipment installed in Electronic Classrooms (ECs) is generally more competent on individual pieces of equipment or software and less skilled on the system as a whole. In addition, turnover due to change of duty station leaves the schoolhouse without a cadre of teachers able to train new instructors how to use the EC. There are significant costs associated with EC underutilization. The most significant are the high overhead fees incurred by supporting instructors who cannot function independently. This paying for additional administrative support that adds no value could prevent schoolhouses from fully achieving their EC mission – providing automated instructional delivery systems that take advantage of current and future technology to enhance student interaction with course material and increase understanding and performance.

This paper discusses the theoretical background of EPSS' including instructional strategies associated with adult learning theory and links theory to design to provide a conceptual framework for building an EPSS, not just for ECs but for any system that is supported by a Training System Utilization Handbook. It also discusses the overall design strategy, how it was developed, and how the EPSS supports the user.

ABOUT THE AUTHOR

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Electronic Performance Support – a software environment that provides a context within which work is done (Brown, 1996); an integrated electronic environment available to and easily accessed by employees that is structured to provide immediate, individualized on-line access to the full range of information, software guidance, advice and assistance, data, images, tools, and assessment and monitoring systems to permit job performance with minimal support and intervention by others (Gery, 1991).

INTRODUCTION

Technologies should be thought of as tools to help learners transcend the limitations of their minds (e.g., memory, thinking, or problems-solving limitations) (Pea, 1985). When learners use technologies as partners, they off-load unproductive tasks, allowing them to think more productively (Perkins, 1993). The Executive Review of Navy Training (ERNT) (2001) established the Navy's interest in the human performance needs of its military personnel by recognizing that job performance and, ultimately, the bottom line are functions of what sailors know and how well they apply that knowledge to accomplish their jobs. Human performance seeks to provide interventions that ensure employees possess the competencies necessary to do their job. Performance support systems augment this requirement by providing information to accomplish the job while the worker is working.

THE NEED FOR AN ELECTRONIC PERFORMANCE SUPPORT SYSTEM (EPSS) TO SUPPORT MILITARY-USE ELECTRONIC CLASSROOMS (ECS)

It has been observed by personnel who train Navy instructors how to operate military-use ECs that their performance while using the classroom is generally more competent on individual pieces of equipment or software and less competent on the system as a whole. This can be attributed to several factors:

- Many instructors are using EC technology as a teaching medium for the first time. This has been a major barrier to their successful utilization. Where previously instructors enjoyed the autonomy of presenting their lessons via overhead projector and lecture some are now experiencing difficulty moving onto Interactive Multimedia Instruction (IMI), web-based training (WBT), or PowerPoint presentations developed by an outside resource that are now delivered via computer and projector onto an electronic whiteboard that advances slides via electronic pointer or air mouse.

- The role of the instructor has changed from standing in front of a classroom and delivering instruction to acting as a facilitator that provides students with opportunities to make use of expert thinking and the modeling of processes and acting as a mentor by reviewing the student's work and providing feedback. Along with this new role is an emphasis on using technology as the preferred teaching/training medium.

- Turnover due to change of duty station leaves the schoolhouse without a cadre of teachers able to train new instructors how to fully use the integrated system.

There are various and significant costs associated with instructor underutilization of the EC, consequences of which show up in "limited results" (e.g., limited productivity or inadequate quality of instruction) that translates into capabilities of the classroom not being fully exploited. This, in turn, causes ECs to fail to achieve anticipated benefits due to partial implementation, inadequate utilization, or acceptance. While not inherently obvious, there are significant costs associated with underutilization of these classrooms. The most significant are the high overhead fees incurred due to supporting instructors who cannot function independently (e.g., those consistently needing to be shown how to use the equipment or software, those that need administrative personnel to set up the EC before they can use it, or those that choose to function independently from the classroom tools, using more labor-intensive steps to achieve the same results). This consumption of overhead resources that, in essence, pays for doing the same work twice could, in the long term, prevent military training commands from fully achieving their EC mission – providing automated instructional delivery systems that take advantage of current and future technology to enhance student interactions with course material and increase understanding and performance.

After providing face-to-face instruction in how to use the hardware and software, EC trainers then administered a Level 1 evaluation questionnaire to measure the learner's opinion of the training. The purpose of the evaluation was to determine the following:

1. Whether the training met instructor expectations
2. Whether the instructors found the training beneficial
3. What content did the users find most difficult to comprehend

171 instructors responded to the questionnaire. Analysis of the data indicated that the user manual and other leave behind materials were not adequate to address questions newly-trained instructors had once EC trainers had completed instruction. Data also indicated instructors were having more problems understanding the operation of software applications than they were using the actual software. After formally presenting these observations to the training command's instructional designers, it was proposed that a solution could be found in the design of an EPSS. It is believed that an EPSS for EC users is a good fit because the system can provide on-demand access to resource data tailored to the current configuration of the classroom; it can be integrated into the work environment by making information accessible to instructors as they perform tasks; it provides support on demand by furnishing information as it is needed; and because the EC itself can support the technology, negating the need to buy expensive support equipment. These features were all proposed by Brown (1996) as major reasons an organization should choose an EPSS solution.

REVIEW OF THEORETICAL RESEARCH ON EPSS INCLUDING INSTRUCTIONAL STRATEGIES ASSOCIATED WITH ADULT LEARNING THEORY

Following is a brief discussion on research that was conducted on adult learning theory. Tenets discussed in this section will be linked directly to the instructional model that was the basis of the EPSS design later in this paper. The emphasis on experience as a defining feature of adult learning was expressed by Lindeman who stated, "experience is the adult learner's living textbook" (1926, pg. 7) and that adult education was, "a continuing process of evaluating experiences" (pg. 85). Carl Rogers was a clinical psychologist best known as the founder of "client-centered" or "non-directive" therapy. His theory on experiential learning for adults was influenced by his humanistic approach to psychotherapy and provides the basis for instructional strategies appropriate to an EPSS environment. Rogers (1969) proposed:

- Significant learning takes place when the subject matter is relevant to the personal interests of the student.
- Learning that is threatening to the self (e.g., new perspectives) is more easily assimilated when external threats are minimized.
- Self-initiated learning is the most lasting and pervasive.
- Self-evaluation is the principal method of assessing progress or success (TIP database, 2003)

Rogers' theory of learning had a direct impact on another adult learning theorist, Malcolm Knowles. Knowles was a widely known figure in adult education from the late 1950's through 1979. His work became a significant factor in reorienting adult educators from "educating people" to "helping them learn" (Knowles, 1950). While Knowles' work was generally dismissed by academia of his time because it challenged the more traditional views of educational ideology, perhaps through today's more technology-based ideologies, Andragogy has finally found a niche. (The term Andragogy was originally defined as the art and science of helping adults learn. It has taken on a broader meaning since Knowles' first edition of Modern Practice and it is currently recognized as an alternative to pedagogy and is now defined as learner-focused education for people of all ages [Learnativity.com 2003]).

In *Modern Practice* Knowles wrote, ". . .At its best, an adult learning experience should be a process of self-directed inquiry, with resources and materials being available to the learner, but not imposed on him." (1970) He proposed three reasons for self-directed learning:

1. Adults who are proactive in their learning, learn more and learn better, than people who wait to be taught. They enter into learning more purposefully and with greater motivation and tend to retain and make use of what they learn better and longer (Knowles, 1975: 14).

2. An essential aspect of maturing is developing the ability to take increasing responsibility for ones own life – to become increasingly self-directed (Knowles, 1975: 15).

3. Students entering into an educational program without having learned the skills of self-directed inquiry will experience anxiety, frustration, and often failure (Knowles, 1975: 15).

Schunk and Zimmerman (1994) defined self-directed learning as the process whereby students activate and sustain cognitions, behaviors, and affects that are systematically oriented toward the attainment of their goals. When looked at collectively, these theorists suggest that a large part of self-regulation is associated with managing the learning environment. A defining condition for self-regulation, then, is the availability of choice and control for learners (Zimmerman, 1994).

Additional theoretical assumptions underlying Knowles' Andrological Model include:

- Adults tend to take a problem-centered vice subject-matter orientation towards learning.
- Adults possess a lifetime of experiences that can serve as a resource for learning.
- Adult learners are very goal-oriented. They know what they want to learn and choose classes appropriate to that goal.
- Finally, adult learners are autonomous.

Instrumental to adult learning is motivation. Motivation is the process whereby goal-directed behavior is instigated and sustained (Schunk 1990). Weiner (1990) further stated that motivation was a work-related vice a play-related concept. Keller viewed the task of motivating learners as critical to achieving a desired performance in learner-centered instructional tasks. Motivation can be influenced by one's need to achieve locus of control and is also a function of the learners understanding of the task at hand, about the consequences of task completion, and about one's ability to do the task (Driscoll, 2000). The ERNT Report also included a section on motivation and stated that findings from research literature indicate that motivation is an important factor in learning. Factors that motivate students include: relevance of the material (particularly for adult learners who are much more motivated when they understand why they are learning something), and the degree to which the training can help the learner obtain valued outcomes (e.g., promotions, effective performance). (2001, pg. 24)

A strong source of motivation comes from learners' beliefs about themselves in relation to self-efficacy (e.g., a person's belief in their ability to perform in order to achieve a desired outcome). Self-efficacy influences the course of action people choose to pursue, how much effort they put forth in given endeavors, how long they will persevere in the face of obstacles and failures, and the level of accomplishments they realize (Bandura, 1997).

CONTEXT AND PARAMETERS OF THE LEARNING ENVIRONMENT

As previously stated, there are three indicators that point to the underutilization of the EC. Many instructors are using technology as a teaching medium for the first time, the role of the instructor has changed from standing in front of a classroom and delivering instruction to acting as a mentor/facilitator, and the high incidence of turnover due to change of duty station. These factors have all combined to create a gap between required and actual proficiency when using various components of the EC. While offering additional face-to-face instruction by a training contractor or converting the contractor's lecture to a computer-based training format were both viable options, an analysis of all variables concluded that, in the long run, it would be more advantageous from a cost and schedule perspective to develop an EPSS because it could be installed on each instructor workstation to ensure instant access when needed. It was also determined that the EPSS could be used as a resource by new instructors, following their initial training period, to become more proficient in the use of classroom hardware and software when conducting classes.

Target Audience

The following paragraphs identify the various personnel categories that manage or conduct training on the EC. A brief description has been provided for each category.

- Student Administrators set up classes and have at least one-year of experience performing this duty. They generally possess a basic knowledge of computers and have some experience with Microsoft Windows and word processing tools.

- Curriculum Developers may also perform the duties of an instructor and normally have less than one-year of experience performing this duty. They are generally comfortable with computers and possess experiences that range from working with Microsoft Windows to using word processing tools, graphics tools, and Toolbook.

- Instructors may also perform the duties of a curriculum developer and have at least one-year of experience performing this duty. Their computer knowledge varies from little or no experience to experience with Microsoft Windows and word processing tools.

All personnel will have at least a high school education and may have some college. They will all have been through varying levels of Navy technical training by attending initial and career school. Prior to serving in an instructor billet, they will also have taken a basic instructor course provided by the Navy.

The average age of all personnel is 32 years; however, this can vary from 28 to 45 years.

They are generally in good health and will come from a variety of racial/ethnic backgrounds.

SOLUTION

General Knowledge Domain

The general knowledge domain of this EPSS focuses on answering instructor questions on how to use hardware and software installed in the EC either while preparing for a class or during the course of instruction. For example, suppose an instructor is teaching a course and needs assistance with how to monitor a student workstation. The instructor can access the EPSS and search the system by typing a key word or words, (e.g., Monitoring or Student Response System), the system would then display topics that pertain to information related to the search criteria. The instructor selects the topic that addresses his question, reads the information, and then continues on with instruction.

Learning Outcomes

The goal of this EPSS is to provide an electronic affordance that allows instructors to fully exploit the capabilities of the EC. The key to its success can be seen in how well the information is organized and delivered. Instructors need quick answers to specific questions without having to dig through pages of technical manuals or screens of text to find them. Learning outcomes of this design address underutilization issues by providing explanations on hardware and software components, checklists for primary instructor tasks, and step-by-step procedures to accomplish each phase of a task. Short demonstrations, or tutorials, are linked to the system to provide an audio and visual example of task performance. The demonstrations also include screen shots of classroom software enhanced with pointers to specific screen areas along with a narration that explains the performed action.

Following is a list of outcomes facilitated by this design:

- Increased knowledge of EC components and overall system operation.
- Easy access to information needed to perform an EC task.
- Ability to identify actions appropriate for a particular set of conditions.
- Cognizance of the interrelationships between the Instructor Workstation, the Student Workstation, and the Classroom Presentation System.

DESIGN & DEVELOPMENT

The general principle of providing a continuously available, “just-in-time” resource to EC users to reduce the learning curve and improve performance is the basis of this design. The EPSS follows the design strategy proposed by Gloria Gery (1991) but was modified to combine the advisory and information components. A training component and the user interface component were also designed.

The instructional model for this EPSS is based on the following tenets of adult learning presented earlier in this paper:

1. Significant learning takes place when the subject matter is relevant to the personal interests of the learner. Because the focus of this EPSS is applicable to the instructor’s day-to-day work it is relevant. Instructors do not have the time nor are they interested in learning for learning’s sake; therefore, the EPSS focuses on providing knowledge relevant to the job of using an EC. An added benefit of this design is that instructors that can demonstrate an ability to use the EC will gain confidence and avoid negative judgments of their competence from the students they are training. A principal tenet of the Science of Learning identified in the ERNT Report stresses that building confidence in learners is an important outcome of training (2001, pg 24).

2. Learning proceeds faster when the threat to self is low. This tenet is manifested in several ways: the instructor is not required to have a deep understanding of the EC because the EPSS can run in the background during class time. If the instructor has a particular question, he can type a key word in the input field and get an immediate response. If a deeper understanding is desired, additional information can be accessed via the advisory/information component or additional instruction can be accessed via the training component outside of class time. Records of instructor ability to use the EPSS will not be kept; however, it would be possible for training commands to maintain an administrative record of where in the system the instructor went, how many times a section of the EPSS was accessed, or if a keyword search was performed for a task that was not included in the system. This information could then be used to provide information to trainers of the EC on additional areas to focus on during face-to-face instruction. It could also be used as a basis for recommending additional topics to be developed for the system.

3. Instruction developed for adults should recognize the value of experience in learning and apply appropriate concepts to the participants. Adults (instructors) have accumulated a foundation of life experiences and knowledge that includes work-related activities, family responsibilities, and previous education (Lieb, 1991). Connecting to this experience base in the EPSS environment can occur in numerous ways depending on the instructor's familiarity with the various technologies. A good example of this is seen in the format for the Tri-Pane Window (Figure 1) and the Toolbar. Because the format is similar to how Microsoft Word® displays Microsoft Word Help® from the Help menu, the learning curve on how to use the EPSS decreases because instructor's can draw on past experience with a similar "help" system environment.

4. An educational program must show adults how it will help them attain their goals. Adults are very goal oriented. This EPSS is clearly defined and well organized so users can quickly find what they are looking for, review it, and then rapidly exit back to the original starting point. Since the instructor determines the path or sequence of information viewed and learning is user-initiated and inquiry-based, they will quickly grasp how the tool can help them increase their competence or understand or master something new.

5. Adults are autonomous. Specifically, they must be free to direct themselves. An inherent goal of this EPSS is to provide a learning environment that involves the learners as partners by allowing instructors to investigate topics that reflect their interests.

6. Motivation to learn is critical. If the instructor does not recognize the need for this EPSS, he will not use it. The design of the EPSS encourages instructor's to display what Dweck and Leggett (1988) called a "mastery-oriented" pattern of motivation. That is, they will select challenging tasks, believed to benefit learning, and demonstrate persistence in those tasks (Elliott & Dweck, 1988; Dweck & Leggett, 1988). While another common motivation will be to keep abreast with advances in technology, the EPSS will also provide knowledge and skills necessary for professional advancement.

7. Self-evaluation should be the primary method of assessing progress or success. One of the main purposes of keeping instructional records is to enforce sequencing. Because the user will be allowed to follow their own path, there is no need to keep these types of records. Users evaluate their learning outcomes and determine whether additional instruction is required based on performance.

This EPSS was designed and developed to be a software system that contains a set of features and functions specific to EC components installed in electronic classrooms. The use of performance support technology to support the use of EC hardware and software is a new concept. What is also new is this EPSS was built upon the premise that learning can be treated as either an individual object or a process. The following discussion fleshes out the designed components.

Advisory/Information Component

The advisory section of this component provides help when needed and takes the form of an electronic job aid. The instructor is not required to have a deep understanding of the EC to use the advice. If a deeper understanding is desired, additional information can be accessed via the information section or additional instruction can be accessed via the training component. Information contained in this section will

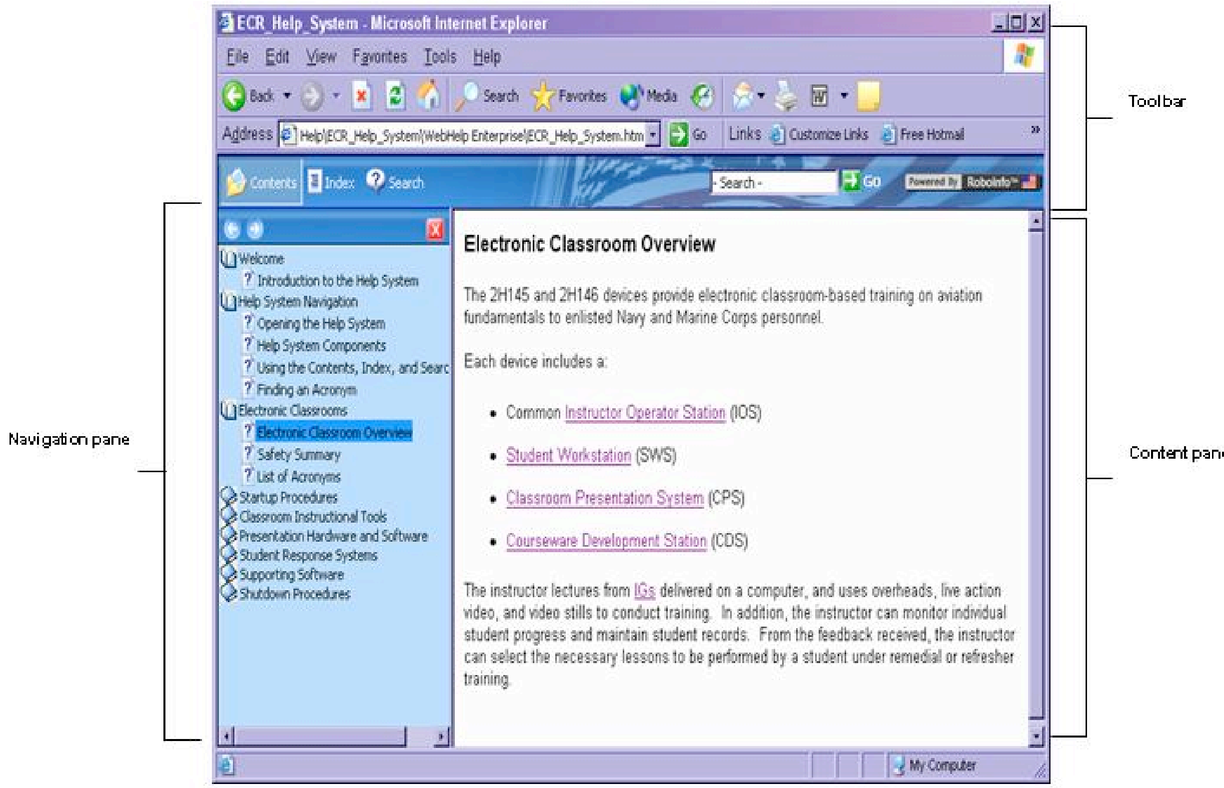

Figure 1. Tri-Pane Display

include: introduction to the EPSS, a safety summary, EC component overviews (e.g., EC Overview, Instructor Station Overview, Classroom Presentation System Overview, Student Workstation Overview, Courseware Development Station Overview), and an acronym list.

The information section of this component will provide content the instructor needs to use the EC. This section consists of hypertext links, an on-line help feature, infobases of data (e.g., checklists and procedures, and multimedia such as digitized photos, audio, and video) along with tools needed to access the information. Hypertext links provide a non-linear way to view information the user is interested in. With hypertext, the instructor can run through information relevant to his purpose. Information is structured so an overview is encountered first. If the instructor wants more details, he can get it via hyperlinks embedded in the text. Using this scheme allows one instructor to access overview information and another to read more detailed information if he so chooses. The advisory/information component of the EPSS will answer the following types of questions (Selen & Nichol, 1990):

1. Goal-oriented questions that discuss the overall purpose of the component. The amount of detail required is dependent upon the expected knowledge level of the user. A high instance of novice users is anticipated; therefore, this part of the EPSS will be fairly detailed.

2. Descriptive help answers questions regarding specific EC components and will cover questions like . . . "How do I?" and "What does this do?" Part of the content analysis focused on addressing these types of questions, results were embedded in the on-line help function.

3. Procedural help answers questions that cannot be addressed by descriptive help. The on-line help system addresses these questions at a high level and provides links to a demonstration of the procedure along with screen shots.

4. Navigational help questions are common in hypertext applications because users can get lost after following just a few hyperlinks. The solution to this problem is provided by a job aid in the form of information books that indicate where the student is with respect to the entire application.

The format and navigation of the EPSS is important to its successful use. The system displays information in a non-linear method to allow the user to determine the path of review. While the system is delivered in an HTML format, an active internet connection is not required. The specific unit of information that displays is called a topic. The tri-pane window format (Figure 1) is similar to any web-based application help, by including a toolbar, a content pane, and a navigation pane. Topics display in the Content Pane on the right side of the window and include text, graphics, hyperlinks, video, and audio. The Content Pane also displays topic information and includes hyperlinks to other topics, expanded text information, drop-down text information, pop-up or rollover text information, and demonstration tutorials.

The Toolbar is a standard browser-based bar. The instructor uses browser keys to go back to previous screens, forward to additional screens, and to print an active display pane. If connected to the Internet, web search features are also available.

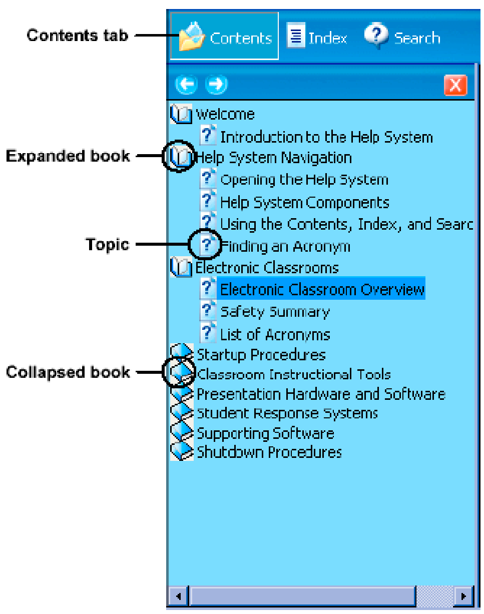

Figure 2. Contents Tab Display

The Navigation Pane on the left side of the window provides the user with several options when searching for information. The first of these search options is the Contents Tab (Figure 2) that outlines contents of the EPSS by indicating information books that expand to display associated topics. The Contents Tab is organized logically, with descriptive book and topic titles, so users can easily find information provided on a particular subject, (e.g., startup procedures, classroom instructional tools, hardware and software, student response system, courseware development procedures, and shutdown procedures.) With the books collapsed, a broad overview of the main subject area is provided to display the scope of information contained in the EPSS.

In addition to the Contents Tab, the EPSS includes an index as a second search option to locate specific information within the system. Users with a particular question in mind can type a key word in the input field of the index. As the user types, index entries begin accommodating display words that begin with the typed letters. Clicking on the index word displays a list of topics relating to the index entry (Figure 3). The instructor can click on a topic title to display the information.

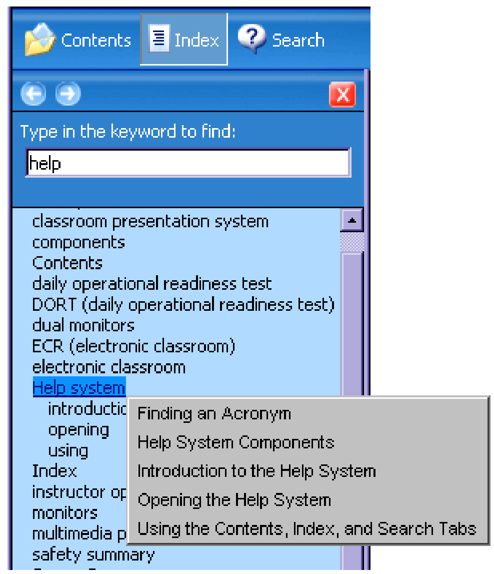

Figure 3. Index Tab Display

A third option is full-text search. Users can look for any word that occurs within the content of the system and can access corresponding topics by clicking on those that display (Figure 4). In contrast with the index search function, the full-text search database catalogs every word in the system, not just index entries.

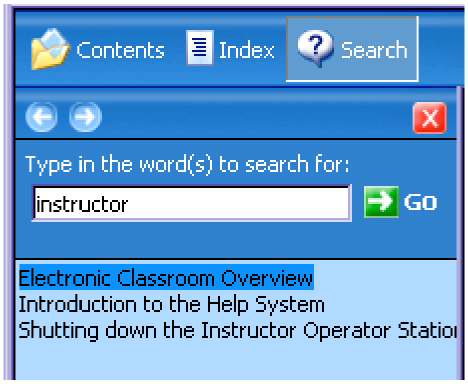

Figure 4. Search Tab Display

Training Component

The training component is provided so instructors can access training on demand. This component mimics traditional computer-based training (CBT); however, information is accessible in a non-linear structure to permit flexible navigation ensuring instructors can construct individualized learning sequences. The overall system differs from traditional CBT in the following ways:

- The viewing of prerequisite knowledge is not enforced, it is up to the instructor to determine if they need to review this information.

- Student records will not be kept. One of the main purposes for keeping records is to enforce sequencing of instruction. Because the user will be allowed to follow their own path, there is no need to keep these types of records.

- Instructional units are available as self-contained, stand-alone elements representing chunks of information that cannot be further subdivided and still maintain meaning. The instructor enters the training component to learn a specific task and the lesson segment will only cover that task. This strategy supports the overall purpose of the EPSS in that if lesson components contain more information, the instructor will take longer to complete the original task. Dependence on other lesson segments will be limited because there is no guarantee the instructor has previously viewed them, minimize any undefined acronyms, and restrict the use of backward references.

- Instructors will not be required to sign into the training component and they will be allowed to escape at any time.

- Information pertinent to the training component will be linked to other components. This will avoid the duplication of information and greatly reduce development and life cycle maintenance costs.

User Interface Component

The user interface component is the single most important aspect of the design because it provides structure to access components and links to tools that display information, advice, and training. The design is based on an interface common to those familiar with the Windows environment to present a consistent look and feel to all components. Hypertext links are used to build the branching of decision trees for the advisory/information component to further ensure the interface is consistent throughout the system.

The EPSS is delivered in a browser-based, cross-platform format and can be distributed on CD-ROM or loaded on a hard drive or network server. If the user chooses to publish files to a web-based server that includes a feedback engine, information on the amount and type of use can be collected. User feedback reports will identify areas of the EPSS that are being accessed and areas where information is requested, but not found. This way content can be updated and continually refined based on actual user experiences with the system.

One of the strengths of the EPSS is that a single source project can be used to generate the web-based, browser-based, and HTML help. In addition, updated information, tutorials, or links to supporting documentation can easily be added with no degradation to the original development effort.

CONCLUSION

The primary goals of the EPSS' design were to increase knowledge of EC components and overall system operation; provide information needed to perform an EC task; identify actions appropriate for a particular set of conditions; and, building cognizance of the interrelationships between the Instructor Station, the Student Workstation, and the Classroom Presentation System. These goals are achieved by providing an environment that develops skills in the use of individual EC components that are applicable throughout the user's assignment to the training command as well as in future professional activities. In addition, the design provides strategies that address Science of Learning issues identified in the ERNT Report (2001) as well as linking learning theory to the design to provide a conceptual framework for building electronic performance support systems in the future.

It is important to note that even though this EPSS was specifically designed to support EC components, the overall design strategy can be applied to any piece of equipment that is supported by a Training System Utilization Handbook (e.g., large-scale or part-task trainers, simulators, etc.).

Given the evidence of a lack of proficiency in the use of an EC at military training commands, it can be assumed that any EC user could benefit from a system that provides access to training and use questions on demand. This EPSS provides a framework for focusing instruction on tasks associated with expertise in the use of EC components that will ultimately enhance overall instructional effectiveness.

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