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UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

DELIVERING CONTINUING PROFESSIONAL EDUCATION AT A DISTANCE: THE CORRELATION OF FIELD DEPENDENCE/INDEPENDENCE AND LEARNING USING THE WORLD WIDE WEB

A Dissertation

PRESENTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

Doctor of Philosophy

by

Kari E. Boyce, M.Ed., RDMS, RDCS

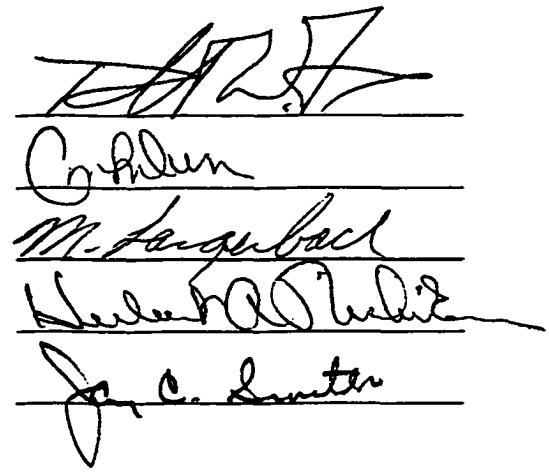
Norman, Oklahoma

1999

DELIVERING CONTINUING PROFESSIONAL EDUCATION AT A DISTANCE: THE CORRELATION OF FIELD DEPENDENCE/INDEPENDENCE AND LEARNING USING THE WORLD WIDE WEB

A Dissertation
APPROVED FOR THE DEPARTMENT OF
EDUCATIONAL LEADERSHIP AND POLICY STUDIES
The University of Oklahoma

By



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"The world is round and the place which may seem like an end may also be only the beginning." Ivy Baker Priest

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ABSTRACT

The purpose of this study was to determine if field dependent (FD) and field independent (FI) learners differ in performance, completion rates, their sense of 'becoming lost', or navigational style when using WebCT in conjunction with a web browser to access a hypertext continuing professional education module available via the World Wide Web. The educational module content included a pre-module test, a post-module test, seven hyperlinked lessons about ultrasound equipment quality assurance, seven corresponding quizzes, two relevant printable forms, an interactive sonography imaging tool, a glossary and an index.

Data was collected electronically via web-based forms and WebCT databases. Each participant was expected to complete a paper and pencil or web-based form of the Hidden Figures Test to establish an individual score along the FDI continuum. Additional demographic, situational and evaluative data were collected via web-based registration and feedback surveys.

During a two month period, 114 participants registered and 37 completed all module requirements. The sample population was predominantly practicing, registered sonography professionals and sonography students from Oklahoma and surrounding states. Data analyses included t-tests and chi-square analyses as appropriate for continuous and categorical variables.

Learner performance on some module tests and quizzes demonstrated a practical as well as statistically significant difference for FD and FI groups, as expected from review of the literature. Learner completion rates, frequency of reporting a sense of

'becoming lost', and navigational style were not found to be significantly different for FD and FI groups, by practical or statistical standards.

Field independent participant scores showed an advantage on performance measures. Field dependence/independence was not predictive of learner completion rates, frequency of reporting a sense of 'becoming lost', or navigational style. The results from this study provide a framework for continuing and expanding this viable and relevant area of research.

CHAPTER I

INTRODUCTION

Background and Significance of Study

The past ten years have seen a dramatic increase in use of personal computers for office procedures, entertainment and education. **Hypertext** is one type of computer document which has educational application. Hypertext documents permit words or phrases to be linked to other text, images, sounds or documents (Ayersman, 1993; Jonassen & Wang, 1993; Nelson, 1987; Spiro & Jehng, 1990). Selecting a desired word or phrase brings associated or linked data to the computer screen. An advantage to this document design is that information does not have to be presented or read linearly, as in a traditional textbook (Stanton & Baber, 1992). Flexible formats permit learners to explore selected links in greater detail and seek answers to questions at the time they arise (Duchastel, 1990). A major challenge for learners is navigation through the large number of available choices to reach desired information. As a result, there is a risk that learners may lose their way within a hypertext document or fail to remain on task (Hammond & Allinson, 1989; Hsu, Frederick, & Chung, 1994; Small & Grabowski, 1992).

Recently, the Internet has become a dominant force in shaping hypertext applications. As methods to deliver and retrieve information via Internet have improved, additional hypertext environments have rapidly emerged. A subset of the Internet known as the **World Wide Web** (WWW) consists of hypertext documents which are linked over the Internet and other computer networks at the discretion of the authors (Krol, 1992). **Web browsers** are software programs designed to allow the user to "read" hypertext

documents. Basic functions of web browsers include viewing documents and following links embedded in the text. A significant feature of the WWW is that hypertext documents are available for browsing 24 hours a day at the discretion of information providers. These features allow authorized users to access information at their convenience. Currently the most popular web browsers are: Netscape Navigator and Microsoft Internet Explorer. (Gibbs, Sullivan-Fowler, & Rowe, 1996; Tedeschi, 1998).

Currently the **Oklahoma Telemedicine Network** (OTN) is involved in a unique opportunity to make continuing professional education available to rural health care professionals in Oklahoma via the WWW. Personnel at rural health care facilities have specifically requested that educational resources be made available via this computer network. Formatting these educational programs as hypertext documents, which are translated using a web browser, is currently considered the most convenient delivery mechanism.

OTN educational hypertext documents are primarily stored on computers physically located in Oklahoma City and data are accessed by request via the web browser software on the computers of rural health care providers. Health care professionals have the choice of following available links to navigate the information (i.e., underlined words, forward, back, home) and/or using search tools to find additional links related to topics of interest. The hypertext continuing professional education (CPE) module used in this study focused on quality assurance for diagnostic medical sonography equipment. The module was constructed using common contemporary practices for text, graphics, and interactivity (Lynch & Horton, 1997; National Computational Science Alliance, 1996; O'Mahoney, 1995-97) and used an increasingly popular web-course

development, delivery and management tool known as **WebCT**. WebCT is a software tool for developing, delivering, and tracking web-based instruction. Performance measures used in the module to measure learner outcomes were multiple-choice questions based upon the content of the module.

Previous studies exploring relationships between learner performance in hypertext systems and **cognitive style** (specifically, **field independence** and **field dependence**) have shown that field independent (FI) learners tend to perform better than field dependent (FD) learners (Jonassen & Wang, 1993; Weller, Repman, & Rooze, 1994). Additional studies have employed a variety of instructional strategies to permit individualizing the hypertext lesson to the cognitive style of the learner (Abraham, 1985; Ausburn & Ausburn, 1978; Davis, 1991; Leader & Klein, 1994; Lipsky, 1989; Liu & Reed, 1994; Meng & Patty, 1991; Stanton & Stammers, 1990a, 1990b). In these studies performances of FI and FD learners were equalized for some instructional treatments. For example, Leader and Klein (1994) found that the performance of FI and FD learners were similar when using a full complement of navigational tools or a browser.

Use of web browsers for accessing continuing professional education is a novel application of hypertext which is beginning to take root (American Health Consultants, 1997; Feld, Schwabbauer, & Olson, 1996; Flinn, 1996; Lehmann & Hayes, 1995; Lockhart, 1995; Nashad & Fink, 1995-1996; Peterson, Galvin, Mullan, & Rose, 1996). Therefore, it is important to identify groups of learners who may potentially have a performance disadvantage using this educational medium. Supplemental learning strategies may need to be introduced to assist these learners in maximizing their learning experience when using hypertext environments. Based upon previous research on

cognitive style and hypertext applications, it is reasonable to assume that FD learners will have a performance disadvantage when using web browsers for accessing continuing professional education. However, there are unique attributes of web browsers (such as the bookmark, history, and search features) and web-course delivery tools like WebCT (such as the index, search, glossary, page forward, and retrace features) which may provide navigational and contextual cues sufficient to minimize performance variations between FI and FD learners.

Statement of Problem

A large number of studies exist which have explored performance differences between FI and FD learners. FI and FD are considered two extremes of a cognitive style which describe an individuals predominant mode of perceiving and organizing information about the world around them. FI learners are considered to have a performance advantage over FD learners. A subset of studies have specifically investigated FI and FD learners' performance using hypertext applications. This is particularly appropriate because hypertext is characterized by the non-linear nature of its design. The freedom offered by non-linear hypertext may leave the learner lost or overwhelmed by the available choices. Most learners are accustomed to the structure offered by traditional linear media (textbooks, audiocassettes, and videotapes). FD learners have shown to be at a disadvantage using hypertext programs which did not provide additional navigational or structuring tools such as an index or map.

The use of web browsers to access the hypertext-based World Wide Web is a relatively new phenomenon, as is using the WWW for the delivery of CPE (American

Health Consultants, 1997; Feld, Schwabbauer, & Olson, 1996; Flinn, 1996; Lehmann & Hayes, 1995; Lockhart, 1995; Nashad & Fink, 1995-1996; Peterson, Galvin, Mullan, & Rose, 1996). As a result, there is a need to expand hypertext research to include the WWW hypertext delivery environment for CPE. If there are no differences in performance and/or completion rates between FI and FD learners, features and tools available within current WebCT design will be considered broad enough to meet the individual needs of both groups of learners. If there are differences in the performance and/or completion rates between FI and FD learners, further investigation is necessary to determine the types of instructional strategies and/or web interface features needed to improve performance and/or completion rates of the at-risk group of learners.

Issues raised above are particularly important to the success of the CPE offerings of resource management entities such the OTN. Performance and completion rates of rural health care professionals as learners are relevant outcome measures for this type of telemedicine initiative. If a particular group of learners, such as those who are FD, show a lower rate of performance and/or completion, the project managers and educators will need to provide both an explanation of and a solution to the problem.

Purpose

The purpose of this study was to determine if FI and FD learners differ in performance, completion rates, their sense of "becoming lost", and navigational style when using WebCT in conjunction with a web browser to access a continuing professional education hypertext module available via the World Wide Web.

Research Questions

This study attempted to answer the following questions:

1. Do FD and FI learners differ in their ability to correctly answer multiple-choice questions drawn from the content of a web-based CPE module?
2. Do FD and FI learners differ in terms of rate of completion when using a web-based module (WebCT) for accessing CPE?
3. Do FD and FI learners differ in frequency of reporting a sense of "becoming lost" when using a web-based module (WebCT) for accessing CPE?
4. Do FD and FI learners differ in their navigation style when using a web-based module (WebCT) for accessing CPE?

Definition of Terms

bookmark: A feature within web browsers which allows the user to save web addresses to provide hypertext links to selected web pages for later use.

cognitive abilities: These are unipolar, value-laden dimensions which typically refer to content, component processes, level of cognition and are usually domain specific (Messick, 1984). An example is the ability to perform mathematical functions such as addition, subtraction, and multiplication.

cognitive construct: Any cognitive style, cognitive control, cognitive ability, or cognitive strategy.

cognitive controls: Controls provide regulatory influence without the broader organizing features associated with cognitive styles. Controls are usually unipolar, value-

laden, and function or domain specific. Performing a simple, repetitive task, such as brushing your teeth, with a minimum of conscious effort is an example of a cognitive control.

cognitive restructuring: The ability to break up an organized field into basic elements, provide structure for ambiguous information, and provide new organization to information presented with a different structure (Frank, 1983). An example is when a student reorganizes lecture notes, adds illustrations and/or generates a new outline of key concepts from a lesson.

cognitive strategies: Choices made by the individual from available alternatives, influenced by the specific situation, task at hand, the individual's abilities, and may or may not be made consciously (Messick, 1984). Creating a visual representation of a concept before providing a verbal description is a cognitive strategy frequently used by educators.

cognitive style: Characteristic self-consistencies in information processing which usually influence multiple cognitive domains and are considered bipolar and stable over time. The tendency to remember discrete details of visual stimuli is considered a cognitive style.

continuing professional education: Voluntary and/or required educational activities in which individuals from specific professions are engaged as a means to remain current in their area of expertise and acquire additional competencies. Many sonographers participate in local and statewide professional meetings which include lectures addressing specific clinical techniques and pathologic conditions.

distance education: The delivery of education to individuals or groups separated from the provider by time or space. Correspondence courses which rely on mailing educational materials, assignments, and examinations between the instructor and the student represent one of the earliest forms of distance education.

field dependence-independence (FDI): The degree to which perceiving and organizing information is influenced by the surrounding field or framework. **Field dependence (FD)** represents one extreme of the FDI cognitive construct which characterizes learner preference for a global approach to perception, processing, and organization of information. For example, the FD learner tends to give more attention to external, social information than to internal, self-generated cues. **Field independence (FI)** represents the other extreme of the FDI cognitive construct which characterizes learner preference for an analytical approach to perception, processing, and organization of information. FI learners tend to generate their own structure and hypotheses when presented with new information, rather than accepting the data as presented.

hypermedia: "Any computer-based system that allows interactive linking of multiple format information including text, still or animated graphics, movie segments, video, and audio. Allows non-linear traversal" (Tolhurst, 1995, p. 25). Today's cd-rom-based encyclopedias provide an excellent example of hypermedia, because publishers have incorporated text, still images, animated graphics, video segments, and audio into their products.

hypertext: Non-linear text in which a word or words are linked to other text, images or documents within an information storage and retrieval system (Nelson, 1987; Tolhurst, 1995). Links on a web page are a form of hypertext.

hypertext - chunk or basic: Linking of text via text or icons with a unique attribute. When using a web browser, blue, underlined text is the default appearance for a basic hypertext link.

hypertext - collateral: Collections of parallel text which include multiple perspectives or viewpoints on a single topic. Web-based reviews of new technology at http://www.cnet.com/ provide both pros and cons.

hypertext - grand: A comprehensive collection of information pertinent to a specific topic. A hypertext book distributed via cd-rom or the World Wide Web represents the grand form of hypertext.

hypertext - stretchtext: A hypertext information systems which allows the level of content detail to be dynamic (increased or decreased) based on user adjustment of a "text throttle" (Nelson, 1987). This is a type of hypertext which has been proposed, but probably not yet realized.

hypertext linkage - chunk or node-link: A hypertext linkage with the least amount of structure. For example, when any node can be reached from any other node in the system. An example is a website which uses a United States map at the top of each page to provide simultaneous links to information about each state. This allows the user to jump from one state page to any other state page without returning to a main page of the website.

hypertext linkage - hierarchical: A hypertext linkage providing an organized arrangement of nodes, where details are subsumed below general concepts (Jonassen, 1986). This is a common design used by corporate websites. For example, keywords such as "products", "services", "support", and "contact us" are used as top level website organizers with specific content placed under these categories.

hypertext linkage - structured: A hypertext linkage between sets of nodes. The structure within a node set is variable, while links between node sets are fixed (Nelson, 1978). Similar to the hierarchical design, but with more variation in structure under each category.

HyperText Markup Language (HTML): A text-based language for creating computer-platform independent hypertext documents for use over the World Wide Web. HTML is a subset of the Standard Generalized Markup Language (SGML). These languages use special codes placed adjacent to standard text. For example, <B>education</B> produces the word **education** in boldface type on a web page.

interconnectedness: The ability to establish associations among content nodes. Creating a hypertext link implies an association between the link and where it leads (a target).

Internet: A global network of computers which provides a means to distribute and retrieve information. The World Wide Web represents a subset of the Internet.

knowledge construction system: A system which allows learners direct control of information and information links. An ideal example allows learners to add, edit, and/or delete information and links between information.

knowledge presentation system: A system which provides searchable relational databases. For this system, the focus is on the ability to retrieve information which is presented to the user.

knowledge representation system: A system which uses graphic links to indicate information interrelationships. This system is designed to show relationships within information. Microsoft FrontPage is one of several web page design tools which produces a visual map of the relationships among all the web pages at a website.

learner control: The degree with which a learner has control over decisions related to instructional content and pace. A basic level of learner control is when the learner can stop and replay an instructional lesson.

learning strategies: See "cognitive strategies".

learning styles: Preferences or general tendencies for information processing which are less specific than cognitive styles. The tendency to engage in hands-on educational activities demonstrates a preference for kinesthetic learning.

mental abilities: See "cognitive abilities".

multimedia: The use of two or more formats of media for presentations (e.g. text, slides, video, audio, animation). The presentation may or may not be computer-based. For example, a slide presentation accompanied by music is multimedia.

semantic structure: A method of representing the linkages of nodes of information in a web-like arrangement. For example, a group of learners may be asked to create a diagram which identifies concepts covered in class and to draw lines between concepts to show associations between the terms. This diagrammatic

representation or concept mapping is used to help students sort and articulate the relationships among information and ideas.

World Wide Web (WWW): A collection of hypertext documents and multimedia which are linked over the Internet and other computer networks at the discretion of the authors (Gibbs, Sullivan-Fowler & Rowe, 1996; Krol, 1992). Http://www.ou.edu is the WWW address for the University of Oklahoma's website, which includes several network servers and other computers on both Norman and Health Sciences Center campuses.

web browser: A software program designed to allow the user to view and interact with hypertext documents or web pages on the World Wide Web. Netscape Navigator and Microsoft Internet Explorer are currently the most popular web browsers.

WebCT: A software program which facilitates creation, delivery, and management of educational web pages. For example, WebCT integrates course content pages, quizzes, student performance tracking, discussion groups, and email into one software interface.

Summary

In summary, the WWW provides a unique educational opportunity for users and providers of CPE. Providing web-based hypertext documents allows the learner to select the content and sequence of their educational experience, as well as the time and location. Coupled with this increased flexibility, however, comes greater learner responsibility for navigating through the available choices. This is a significant issue given that FD and FI learners are known to differ in their dependency upon and use of navigational and

contextual cues. This study was designed to provide evidence as to whether or not a currently available web-based instructional tool WebCT adequately supports both FD and FI learners in accomplishing basic educational goals (as measured by performance in and completion of a CPE module).

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

This chapter begins with a brief overview of continuing professional education and distance education to establish the context for this study. The chapter continues with an overview of pertinent literature and research findings in areas of computerized hypertext and the learner cognitive style of field dependence/independence. A summary will be provided at the conclusion of this chapter.

Establishing Context for this Study

Continuing Professional Education

To remain current in an area of expertise and acquire additional competencies there is a societal expectation that professionals will engage in ongoing voluntary and/or required educational activities. A contemporary term for this process is **Continuing Professional Education** (CPE). Some professions use specific designations such as Continuing Medical Education (CME) and Continuing Education Units (CEU). However, CPE is a more inclusive term for these educational activities and will be used in this study. The acronym CME will be used within the text of the experiemental web-based learning module because it is recognized by the target audience.

The definition of profession varies widely, with no generally accepted definition. However, Cervero (1988) has proposed three frameworks or approaches to define professions or professionals which provide an organizing schema for the multitude of definitions. The three approaches to professions are static, socio-economic, and process.

Beginning with Flexner in 1915, the **static** approach was characterized by specific criteria which must be met in order for an occupational group to claim professional standing. According to his criteria, professional occupations:

1) involve intellectual operations,

2) derive their material from science,

3) involve definite and practical ends,

4) possess an educationally communicable technique,

5) tend to self-organization, and

6) are altruistic. (p.6, Cervero, 1988)

Although other authors have added criteria to Flexner's list, there is no consensus about what is essential to a profession and what is the corresponding theoretical framework (Friedson, 1986, Johnson, 1972).

Approaching professionalization as a **socio-economic** issue focuses on public perception of occupations. Public perception of who is a professional and deserving of the status and privilege is tied to the historical context. Public perception is also specific to the community or country involved. For example, members of an occupation may manage their unique "product" and use that to leverage a higher status within a community (Larson, 1977).

The **process** approach assumes that the professionalization of occupations represents a bi-directional continuum (Haug, 1975). As such, an occupation may become more or less professional over time. This perspective also assumes that contributions professions make to society are valuable and sufficient to justify higher income and status in comparison to occupations lower on the continuum (Barber, 1963).

In the United States, the Federal Bureau of the Census maintains categories of professionals, including allied health professions which have minimum education requirements. For example, as of 1996 there were an estimated 58,000 dieticians, 254,000 therapists, 219,000 imaging technologists, and 285,000 clinical laboratory technologists and technicians (U.S. Department of Labor, 1998). While some newer occupations, such as diagnostic medical sonography, have not matured to the point of requiring a college-level pre-professional education or licensure, they do have a voluntary certification process which requires ongoing continuing professional education (ARDMS, 1997). Dialogue within the sonography community is reflective of the process of professionalization. For example, frequent reference is made to enhancing the professional status of the profession through higher minimum education standards and educating the public, other health care professionals and third-party payors regarding the unique occupational responsibilities performed by sonographers.

Delivery of Continuing Professional Education

Continuing professional education is delivered in a variety of settings using numerous formats. Formal group meetings involving lecture and discussion include conferences and seminars. Informal group meetings may take the form of medical rounds, office meetings or dinners. Reading, viewing videos, and completing computer-based instruction are examples of individual learning activities.

As mentioned earlier, CPE learning activities occur in a variety of settings. In addition, they are hosted and sponsored by a wide range of providers. In 1982, Darkenwald and Merriam characterized providers based on relationship of CPE to their overall organizational mission. From a consensus of literature, Cervero (1988) identified

four major CPE providers: university/professional schools, professional associations, employers and independent providers. Table 1 ties together the providers described by Cervero (1988) and their educational mission as articulated by Darkenwald and Merriam (1982).

Table 1

Providers of Continuing Professional Education

Independent Providers	Primary function is CPE
Universities/Professional Schools	Secondary function is CPE
Professional Associations	Quasi-educational function
Employers / Some Equipment/Material Vendors	Supportive function / Non-educational function
Cervero, 1988	Darkenwald & Merriam, 1982

Using the WWW for CPE delivery offers a potential mechanism to increase the number of providers and amount of available material. Benefits include 24-hour access, time-independent delivery, and a growing "library" available as supplemental or stand-alone material. In addition, WWW resources are scalable, allowing the user to "drill" as shallow or deep into the content, as need dictates. Examples of WWW pages which provide continuing education credits for completing modules pertinent to diagnostic medical sonography are available through Acuson, ATL, GE Medical Systems and Jackson Community College (http://www.acuson.com/cme/index.htm, http://www.atl.com/pro_ed/E2102_Casestudy/, http://www.ge.com/medical/ultrasound/msucme.htm, and http://www.jackson.cc.mi.us/CME).

Computer-mediated communication tools are also available for learners to expand their universe of peers and increase accessibility to experts. Examples include: e-mail, bulletin-boards, listservs, newsgroups and customizable search tools. The sonography community is already using these types of Internet resources. Feedback and interactivity are possible with many Internet and WWW tools. There is also a growing compatibility between the WWW and current office computer word processing, spreadsheet, and database products which allow dynamic links from local documents to information on the WWW. This provides additional opportunities for sonographers to prepare and publish case studies and literature reviews directly to the WWW.

Current limitations of Internet and WWW tools for CPE include: finite bandwidth and access speed; variation in quantity and quality of material; potential for user navigation problems; broad range of possible presentation formats (text, graphics, frames, sound, video); and the resultant need to add software plug-ins to achieve full web browser functionality.

In summary, as demand for CPE activities increases among diagnostic medical sonographers and other health professionals, it is likely that the WWW will become an increasingly significant delivery mechanism for both group and individual learning activities sponsored by a wide range of providers. In preparation for this anticipated growth, it is important to identify any groups of learners who may potentially have a performance disadvantage using this educational medium and provide supplemental strategies to maximize their learning experiences.

Distance Education

Linking learners and learning resources separated by time and/or location is a current definition of distance education (Dillon, 1996). A variety of media is available to overcome temporal delays and geographic barriers, however this definition of distance education is not media-specific. The choice of media contributes to the level of interactivity and synchrony of instruction. Over the past 50 years print and audio resources (radio broadcasts, audio teleconferences and tape recordings) have been popular and readily available media for distance education (Moore, 1987; Pittman, 1990; Takemoto, 1987; Treloar, 1985). Since the 1950's the use of satellite, broadcast and closed-circuit television, and distribution of videocassette tapes has expanded the means to provide both one-way and two-way educational communications (Boyar-Naito & O'Keefe, 1979; Fry, Baer, & Cornett, 1976; Wiesner, 1987).

Recent advances in digital technology and the Internet have provided new media and modes for educational presentation and interaction. For example, the delivery of instructional material over the WWW is a relatively new phenomenon (Appleton, 1997; Carvin, 1997; Polyson, Saltzberg, & Godwin-Jones, 1996; Reid, 1997; SyllabusWeb, 1996; Wehmeyer, 1996). The bulk of WWW growth has occurred since 1994 and because of this recency has had limited impact on the current research literature in distance education.

The use of WWW for some learners could best be described as self-structured learning, particularly when documents primarily serve as information resources. However, involvement of an institution in planning and delivering specific instruction using the WWW as a medium for interaction falls within contemporary definitions of

distance education. Other scenarios are also possible. An institution could provide structured instructional content via the WWW which is not accessed until the user/learner perceives a need for instruction (e.g., just-in-time learning). Certainly this scenario holds considerable potential for the continuing education of health care practitioners, including diagnostic medical sonographers. New knowledge holds its greatest potential to impact professional practice when it is used by a learner who recognizes a gap between their current and needed competence (Fox, Mazmanian, & Putnam, 1989). Just-in-time learning via access to pertinent information on the WWW has the potential to meet some of these CPE needs. For example, a sonographer in a rural hospital may be asked to perform follow-up examinations on a local patient who has received a liver transplant. Typically, these follow-up exams are performed in the tertiary-care facility where the transplant procedure was performed. However, in an attempt to reduce health care costs by returning the patient to their home, the responsibility for performing this specialized examination may be placed on the local health care providers. Detailed examination protocols and representative images available on the WWW become just-in-time learning resources for both the sonographer and the radiologist interpreting the results of the post-transplant examination.

Since many providers of web-based education are "new" to the field, attention should be given to recommendations from experts from within the specialty of distance education. Specifically, the design and use of the materials on the WWW for CPE should be consistent with current good practices in distance education. Guiding principles for good practice in distance education should be based upon accumulated experience and research.

Recently a national task force convened by the American Council on Education articulated guiding principles of good practice in distance education as follows:

a) Distance education activities are designed to fit the specific context for learning.

b) Distance learning opportunities are effectively supported for learners through fully accessible modes of delivery and resources.

c) Distance learning initiatives must be backed by an organizational commitment to quality and effectiveness in all aspects of the learning environment.

d) Distance education programs organize learning around demonstrable learning outcomes, assist the learner to achieve those outcomes, and assess learner progress by reference to these outcomes.

e) The provider has a plan and infrastructure for using technology that support its learning goals and activities. (ACE, 1996, p. 12)

Because of the novelty and non-linear nature of newer educational tools, such as hypertext documents available over the WWW, there is a need to continue to expand this research base as it applies to distance education. The research questions posed in this study were built upon prior research findings in the areas of hypertext and cognitive styles of field dependence and independence, within the context of continuing professional education and distance education.

Review of Related Literature

Hypertext - History

The term hypertext was originally used in 1965 by Nelson (1978, 1987) to refer to non-linear text with the ability to link to other related or non-related text within an information storage and retrieval system. Nelson (1987) proposed a unique system which included the ability to modify text locally to meet learner needs, add links and documents to the system and provide worldwide access to a broad range of literature and other material.

Much earlier, Vannevar Bush (1945), in an article entitled "As We May Think", provided the conceptualization of an information system (memex) which would provide meaningful linking of text and other information for individual use. He also foresaw integrating memex collections from colleagues and commercial vendors into personal systems. In 1963, Englebart revisited Bush's challenge, as he recognized the evolution of computer technology was making such an information system possible. The continued progress in computer processing capabilities during the past decade has enabled and invigorated development of hypertext systems currently available for providing informational and educational resources independent of time and location. The following section will provide definitions to clarify the features and term used in association with hypertext.

Hypertext - Definitions

Hypertext provides the opportunity to create a document, module, book, or an entire information system which permits non-linear movement through the text. Many

printed text documents are used in a sequential or linear fashion. For example, a book of fiction represents a text-based document which is typically read in a linear fashion, from front to back.

In contrast, a dictionary, though arranged linearly according to the alphabetization of the defined words, is used linearly only during the search process. Accessing specific words is a non-linear task as the user can jump from one word to another based on need. Hypertext allows electronic documents to be used in a similar fashion. The user can move to and retrieve just the desired information, limited only by design of the hypertext document.

As part of a review of definitions in the literature, Tolhurst (1995) clarified definitions for hypertext and two associated terms: hypermedia and multimedia. Tolhurst provided a functional description of **hypertext** as, "(n)on-linear organized and accessed screens of text and static diagrams, pictures and tables" (1995, p. 25). A functional definition of hypertext proposed by Leggett, Schnase, and Kacmar (1990) focuses on four components: information, abstractions, links and anchors. Each of these components respectively corresponds to content, structure, connections and points of connection.

Functional definitions of hypertext (Leggett, Schnase, & Kacmar, 1990) focus on the physical linkages or structure of the material, while semantic definitions emphasize the potential associations within the content (Spiro & Jehng, 1990; Tripp & Roby, 1990). For example, Spiro and Jehng (1990) point to the possibility of multiple interpretations or experiences available from a single hypertext system in the following passage.

> The term hypertext refers to computer-based texts that are read in a nonlinear fashion and that are organized on multiple dimensions. The same material (which can be any kind of randomly accessible medium, e.g. text, video, audio) is capable of being explored in different ways, with different exploration paths producing what are essentially multiple texts for the same topic. (p. 160)

Note that Spiro and Jehng specify a computer-based system for hypertext (1990). However, there are examples of hypertext which are not dependent upon a computer, including a book compiled in follow-up to a hypertext/hypermedia workshop. The text is entitled "Designing Hypermedia for Learning" and was edited by Jonassen and Mandl (1990). Extensive cross referencing allows the book to be used as a hypertext system. Note that Tolhurst's definition of hypertext quoted earlier is inclusive of these alternative forms of hypertext (1995).

So how does hypermedia differ from hypertext? We return again to Tolhurst's (1995) proposed definitions. **Hypermedia** is "any computer-based system that allows interactive linking of multiple format information including text, still or animated graphics, movie segments, video, and audio. Allows non-linear traversal." (Tolhurst, 1995, p. 25) Therefore, hypermedia differs from hypertext in requiring a computer system and including dynamic material in addition to static images and text.

An additional term, multimedia, should also be defined at this point in the discussion. **Multimedia** refers to

> (t)he use of multiple formats for the presentation of information, including text, still or animated graphics, movie segments, video, and audio

> information. Computer-based interactive multimedia includes hypermedia and hypertext . . . if it includes non-linear interactive links. (Tolhurst, 1995, p. 25)

Multimedia does not require a computer system, in fact, any presentation which uses two or more forms of media, (e.g. text, slides, video, animation, audio) is a form of multimedia. Therefore, the use of multimedia by educators predate the conceptualization of all of these terms.

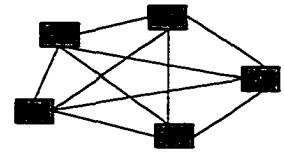
Hypertext and associated linkages have been categorized in several ways which are useful for describing hypertext designs and functions. A discussion of three classification schemes follows: a) types of hypertext; b) type of linkages; and c) general function of the knowledge system.

Several **types of hypertext** have been proposed: chunk, collateral, stretchtext, and grand (Jonassen, 1986; Nelson, 1987). **Chunk or basic hypertext** refers to linking to additional text via icons or text with a unique attribute (e.g. adjacent asterisk, underlined, or colored text). **Collateral hypertext** refers to collections of parallel text. This would include multiple perspectives or viewpoints on a single topic. **Stretchtext** allows the level of content detail to be increased or decreased based on user adjustment of a "text throttle" (Nelson, 1978). Whereas **grand hypertext** is a comprehensive collection of information pertinent to a specific topic.

Implementation of hypertext requires creating a network of nodes of data (text, graphics, sound) linked to other data nodes. According to Jonassen (1986) there are three general **types of hypertext linkages**: node-link or chunk (Nelson, 1987), structured

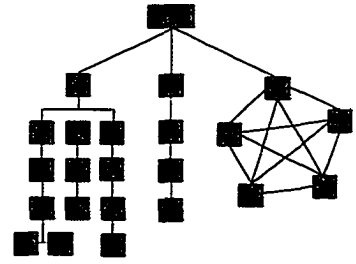
(Nelson, 1978) and hierarchical (Ausubel, 1968). The **node-link or chunk type** has the least amount of structure, as any node can be reached from any other node in the system (see Figure 1).

Figure 1 - Node-Link or Chunk Hypertext



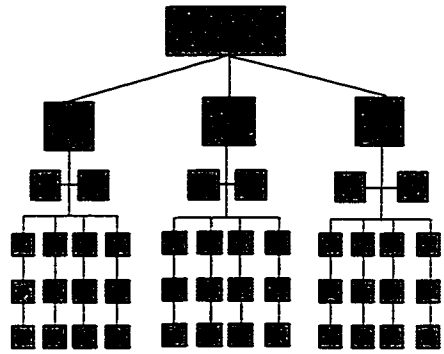
The **structured type** provides linkages between sets of nodes. Structure within a node set is variable, while links between node sets are fixed (see Figure 2). This design is intended to prevent the learner from developing idiosyncratic or meaningless associations between unrelated nodes (Nelson, 1978).

Figure 2 - Structured Hypertext



Hierarchical organization provides an arrangement of nodes, (Figure 3) where details are subsumed below general concepts (Jonassen, 1986). This is compatible with the cognitive theory in which semantic networks are organized in a tree-like arrangement (Ausubel, 1968).

Figure 3 - Hierarchical Hypertext



Another way of characterizing hypertext or hypermedia is as knowledge presentation, representation, or construction systems (Nelson & Palumbo, 1992). Nelson and Palumbo describe **knowledge presentation systems** as those which "provide databases that can be browsed or searched in order to read or view information. Although the information is associatively linked by the author, there are few (if any) attempts to provide instruction to the learner." (p. 291)

Therefore, knowledge presentation systems represent a type of electronic library in which the learner browses or explores as motivated by need or direction. Alternatively, some knowledge presentation systems allow "tours" or preconstructed sequencing of critical

information (Hammond, 1989). Whatever the emphasis of the knowledge presentation system, the links are programmed by the author, not the user.

Knowledge representation systems, as described by Nelson and Palumbo (1992), use graphical illustrations of linkages or webs to indicate the relationships between nodes of information. Ideally, these information maps would represent the semantic structure of the material to be learned.

Finally, the **knowledge construction systems** "support learners in direct interaction with information, allowing them to build nodes and links, annotate, share ideas with others, or even interact in context-rich simulations" (Nelson & Palumbo, 1992, p. 291). The emphasis in this definition is the empowerment of the learner to construct information and interact with the information and other people in realistic contexts.

Global Hypertext - The World Wide Web

The World Wide Web (WWW or the Web) is a contemporary example of a hypertext system that primarily handles chunk, collateral, and grand hypertext arranged in a knowledge presentation system. Available linkages are determined by authors and include node, structured, and hierarchical formats as discussed earlier in this chapter.

The WWW is a subcomponent of Internet, built upon hypertext documents written in HyperText Markup Language (HTML). The WWW was begun by researchers at the European Laboratory for Particle Physics (CERN) who needed a method to share information with colleagues locally and in other parts of the world. Use of a standard language permit documents to be read on any computer that has a software program (browser) which reads HTML. Since 1994 there has been a rapid expansion of

commercial use for advertising, sales, and general public relations. Education institutions have also recognized the WWW as a medium for recruitment, public relations, and instruction.

Browsers are available for most common computer platforms (e.g. PC, Mac, Unix). Introduced in 1994, Netscape Navigator and its successor, Netscape Communicator, have been the most popular browser maintaining a 75 percent of market share through 1995 and 1996. The browser market is now split between Netscape and Microsoft's Internet Explorer (Tedeschi, 1998).

Browsers such as Netscape Navigator and Microsoft Internet Explorer operate using a graphical user interface (GUI). This means that some browser actions are controlled by icons, some which look like push-buttons. Most actions may also be initiated by selecting text visible from pull-down menus. A fundamental element in GUI software is the use of a pointing device, such as a mouse, to select icons or text to initiate a computer action. GUI web browsers usually display hypertext linkages as colored, underlined text.

Popular browsers also include selected navigational tools. Button icons entitled "home", "back", and "forward" allow the user to retrace a search or jump to the beginning or "home" if a search strategy is ineffective or if the user gets "lost". In addition, the color of the hypertext links can be set to change color when links are followed. This provides a color-coded visual path for users to retrace an earlier browser session. "Bookmarks" allow the user to mark documents that they would like to quickly and easily return to later. "Help" is a standard software feature which gives the user sequential instructions for most browser operations. If a user knows the address for a desired

document, the address can be typed into a text field and the user can "jump" directly to the document by pressing return or using the "open" button. Finally, there are pre-existing linkages from the browser to other computers which allow searches to be performed on the growing number of WWW documents.

Hypertext - Potential For Learning

The observation has been repeatedly made that literature about hypertext is rich in proposed benefits and poor in research to support those benefits (Chronbach & Snow, 1977; Clark, 1983; Milheim & Azbell, 1988; Morariu, 1988; Ross & Morrison, 1989; Ross & Rakow, 1980; Tennyson 1980; Tennyson, Tennyson, & Rothen, 1980). The following discussion begins with characteristics of hypertext which appear to have the greatest potential for benefits to learners. The discussion will show overlap of these characteristics, as they are not exclusive of one another. This will be followed by a brief summary of pitfalls related to use of hypertext.

Learner control

Conceptually, hypertext should provide for increased learner control of instructional content and pace (Marchionini, 1988), and this should have a beneficial outcome for learners. Learner control by definition implies that the learner has a role in the decision process, such as selecting content, objectives, sequencing, depth of study, duration and intensity of practice, rate and duration of instruction, and frequency of feedback and exams (Merrill, 1975; Wydra, 1980; Yoon, 1994). Yet, learner control in many educational settings is limited to adjusting the rate of instruction (Jonassen, 1986).

Other aspects of learner control, mentioned above, are potentially available in hypertext systems. For example, Newmark (1989) argues that the non-linear nature of

hypertext encourages the learner to take "responsibility for collecting, organizing, and analyzing information" (p. 56) as they have to in the real world. Because of the choices offered in hypertext systems, there is the potential for learners to match their style to the material by browsing or moving according to their needs and interests (Bevilacqua, 1989). Trotter (1989) also makes the arguments that "having choices and variety lessens the likelihood of boredom; and using a variety of media enhances learning, because text, graphics, and sound reinforce one another" (p. 35). Finally, Carr (1988) contends that when "used properly, [hypermedia] permits the student to concentrate on the material without being distracted by the system which delivers it" (p. 9).

Interconnectedness

Interconnectedness or the ability to establish associations among content nodes is considered a valuable feature of hypertext systems. This feature represents an extension of techniques already in use in traditional media (e.g. table of contents, indexes, glossaries, appendices, references, footnotes, bookmarks, post-it notes, highlights, marginalia) (Bevilacqua, 1989; Kearsley, 1988). Integration of these associated links into hypertext documents provides the opportunity for the learner to make more and permanent connections within the material under study. Bevilacqua (1989) suggests that as a result hypermedia "will probably change our way of thinking; perhaps as we learn how to move non-sequentially in [hyper]texts, the feeling of not knowing where we are will no longer be an issue" (p. 162).

An additional area of theory which is applicable to this feature of hypertext is that of Cognitive Flexibility Theory (CFT). This theory embraces alternative methods of learning based upon the assumption that "oversimplification of complex knowledge is a

significant contributing factor to many examples of learning failure" (Jacobson & Spiro, 1995). As a foundation of CFT, Staninger (1994) proposes: a) educators should be urged to recognize the interconnectedness of knowledge; b) students should be made aware of the web of relationships among groups of facts; and c) students should be helped in developing associations from which they can assemble knowledge.

As a delivery system for education, hypertext designed using CFT offers the opportunity for the learner to: a) improve knowledge transfer by highlighting the "critical interrelationships between abstract and case-specific knowledge components" (Jacobson & Spiro, 1995); b) develop new cognitive methods for organizing complex information (Staninger, 1994); c) use technology which supports adaptive learning (Ellis, Ford, & Wood, 1993); and d) create custom strategies for accessing information, and thereby increasing the likelihood of acquiring needed information (Staninger, 1994).

Semantic structure

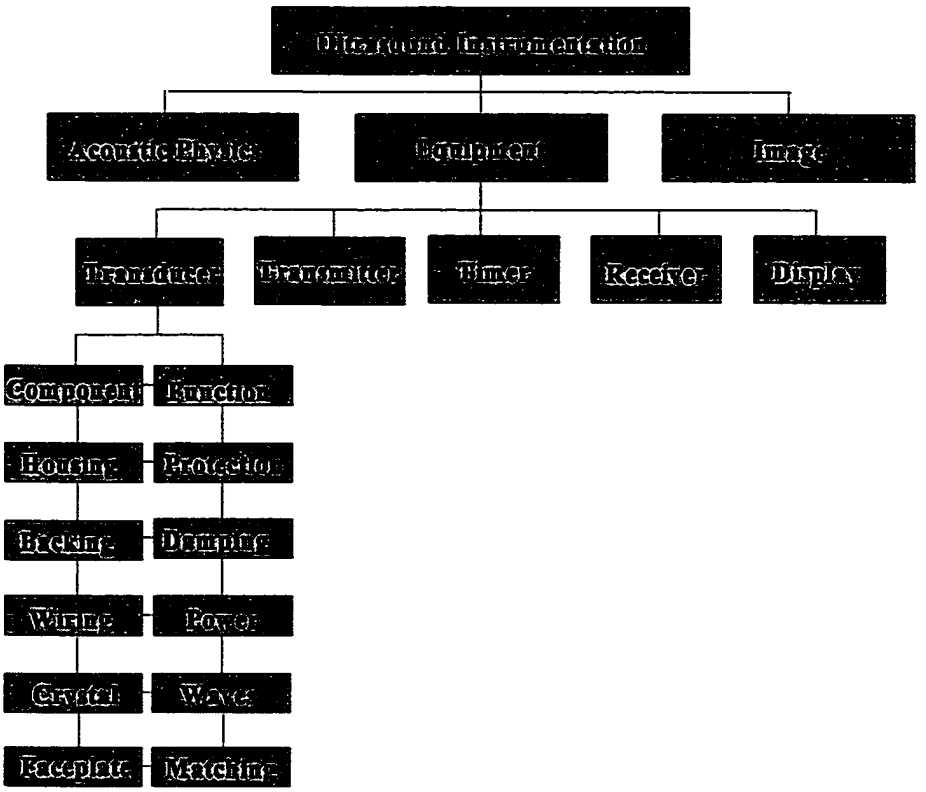
Subject knowledge has been described as concepts or propositions (nodes) and connections between concepts or propositions (linkages). Semantic structure of knowledge expands this analogy to represent nodes of information linked in a web-like network. This spatial illustration of knowledge has been used to represent knowledge structures of novices and experts, as well as prior knowledge and fully elaborated semantic structures.

Learning has been described as acquiring new nodes and constructing additional connections and networks among existing and new nodes. Similarly, hypertext webs can be constructed to emulate desired knowledge structures. Learning should improve as users explore the hypertext content in a manner which weaves new concepts into their

pre-existing conceptual framework (Norman, Gentner, & Stevens, 1976). The conceptual framework grows and is "filled-in" as the learners incorporate new concepts and links (see Figure 4).

Figure 4

Example of a Partial Semantic Structure



Web teaching principles or elaboration theory of instruction using this network structure have been used for designing hypertext instruction (Norman, Gentner, & Stevens, 1976; Reigeluth, 1979). According to this approach, effective instruction builds upon existing knowledge structures (Figure 4). Expanding the framework for information

content is accomplished through instruction that provides general information and overviews. Adding details and relationships to fill in gaps and create an elaborated knowledge structure are achieved using detailed instructional overviews and substructures (Reigeluth, 1979). As a result, hypertext instructional systems have the potential to assist learners in determining their existing knowledge structures, identifying goal knowledge structures, and organizing the presentation and sequence of instruction to enhance their construction of new knowledge networks and semantic structures.

New Learning Strategies

New strategies need to be developed for working within non-linear environments. This will require "learners to constantly make decisions and evaluate progress, thus forcing students to apply higher order thinking skills" (Marchionini, 1988, p. 9). Staninger (1994) suggests that "in order to search effectively, users need to be educated about the capabilities of hypertext, and must be persuaded to think non-linearly" (p. 51). For example, as users gain experience in searching hypertext systems, they build additional connections between information points discovered in the search process. Therefore, search strategies should increase in efficiency and effectiveness as the learners gain experience (Staninger, 1994). New ideas encountered may become focal points for current or future searches, as personal control of the search forces the user to determine relevant topics, and not rely on others such as the author, teacher, or librarian.

Prompt feedback

In addition to recording and scoring learner responses, computer-based learning systems are capable of tracking user search and decision paths, and the time spent at each

hypertext node. Analyses can aid designer and teacher in optimizing the system for learning and assist learners in identifying successful and unsuccessful learning strategies (Bowers & Tsai, 1990).

Hypertext - Pitfalls

According to most related research, the potential for learner benefits described above have not been realized (Chronbach & Snow, 1977; Clark, 1983; Milheim & Azbell, 1988; Morariu, 1988; Ross & Morrison, 1989; Ross & Rakow, 1980; Tennyson, 1980; Tennyson, Tennyson, & Rothen, 1980). For example, many learners are not good at self-selecting the best instructional methods or learning strategies for meeting their individual needs (Chronbach & Snow, 1977; Clark, 1983; Snow, 1980). In fact, Snow (1980) considers the assumptions of learner control (a) that learners can determine what is best for themselves and (b) that learners can act upon their decisions to be indefensible.

Jonassen (1988) warns "the less structured the hypertext is, the less likely users are to integrate what they have learned. Without an explicit external organization, many learners have difficulty acquiring new knowledge" (p. 14). However, Alesandrini (1981) reports that learners process information with their most efficient learning strategies.

Morariu, (1988) points out that "current research on the effectiveness of hypermedia systems is beginning to show that learners may have problems with disorientation in exploring such systems" (p. 17). Many researchers recognize that using hypertext creates a higher cognitive demand than traditional instructional methods (Conklin, 1987; Marchionini, 1987).

There is potential for learners to benefit from control, new strategies, prompt feedback, and interconnectedness of content and semantic structures; however, the

challenges raised by learner disorientation, poor decision making and the need for explicit structure and low cognitive overhead should not be ignored. It appears that learners may benefit most from advisement, coaching, or adaptive prescriptive programs, where suggestions are made to the learner but are not absolute (Arnone & Grabowski, 1992; Chung & Reigeluth, 1992; Jonassen, 1986; Johansen & Tennyson, 1983; Yoon, 1994).

For example, with students having low prior knowledge of the instructional content, Yoon (1994) used the conditions of program control, learner control, and learner control with advisement. Results revealed that FD's had better posttest scores when using learner controlled programs with advisement or program controlled instruction. Under program control, instruction for FDs took significantly less time. On the other hand, FIs required similar instructional times for all three conditions but had their best posttest scores with learner controlled and learner controlled with advisement conditions. As a result, advisement may be a technique for equalizing some performance variations between FD and FI learners.

Finally, Jonassen (1986) notes that whether or not hypertext leads to improvement in academic performance, there is an inherent benefit in allowing the learners to control the process. Stated another way, learner control should be considered a benefit in and of itself.

Cognitive Constructs - Background

Reviewing the literature on cognitive constructs reveals an abundance of studies over the past five decades. This research is an outgrowth of the "New Look" movement which had its birth in the 1940's. The psychologists involved in this movement "... set out to correlate individual differences in cognitive functioning with personality"

(Santostefano, 1991, p. 269). The result is an overwhelming number of diverse research studies and publications addressing a variety of cognitive constructs including: cognitive styles, cognitive abilities, cognitive controls, and cognitive strategies. Despite confusion in definitions and usage of these terms, some common conceptualizations have emerged (Jonassen & Grabowski, 1993; Messick, 1984; Witkin & Goodenough, 1981).

Cognitive style describes "consistencies in the ways in which people perceive, think, respond to others, and react to their environment" (Green, 1985). These variables have traditionally been considered bipolar, value-neutral and stable over time (Messick, 1984; Witkin & Goodenough, 1981), though the value-neutral characterization has been challenged (Davis, 1991; Korchin, 1986; Santostefano, 1991). Cognitive styles are key to the organization and control of cognition, they characterize the manner or mode of cognition and usually influence multiple cognitive domains, such as verbal, spatial, and numerical (Messick, 1984). For example, the visual-verbalizer cognitive style describes the tendency to prefer to process information in a visual rather than verbal manner. When attempting to categorize an object, the analytical-relational cognitive style corresponds with the tendency to focus on object details rather than general features.

In contrast, **cognitive abilities** are unipolar, value-laden dimensions which typically refer to content, component processes and level of cognition (Messick, 1984). Cognitive abilities, usually referred to as **mental or intellective abilities**, are usually specific to a given cognitive domain (Messick, 1984), and more ability is considered more desirable than less ability. For example, numerical ability describes the cognitive manipulation of numeric values, and memory ability identifies the capability to store and recall information.

Cognitive controls, though similar to cognitive styles are more likely to be unipolar, value-laden, and function or domain specific. They provide regulatory influence without the broader organizing features associated with cognitive styles (Messick, 1984). Therefore, cognitive controls represent an intermediate construct, sharing features of both cognitive styles and abilities (Jonassen & Grabowski, 1993). For example, automization describes the ability to efficiently perform simple, repetitive tasks with a minimum of conscious effort. Cognitive flexibility is the ability to resist distractions or conflicting cues to focus on relevant stimuli.

Cognitive strategies refer to choices made by the individual from available alternatives. These decisions are influenced by the specific situation, the task at hand, and the individual's abilities. These choices may or may not be made consciously (Messick, 1984) and may include problem-solving and learning strategies. Examples of such strategies include the use of advanced organizers, rehearsal, mnemonics, paraphrasing, analogies, and self-testing.

At this juncture it is relevant to also define the construct known as **learning styles**. Learning styles are learner's preferences or general tendencies for information processing which are less specific than cognitive styles. Instruments used for measuring learning styles rely on self-reported data.

Assessment of a cognitive ability is usually based upon measuring specific competencies using a maximum performance tool (Messick, 1984; Witkin & Goodenough, 1981). A high accuracy score indicates a high ability and vice versa. For example, to have more is better. This parallels the unipolar, value-laden characteristic of cognitive abilities. On the other hand, measurement tools for cognitive styles should

ideally rely on typical or contrasted performance. Since styles are bipolar and value-neutral, scoring on either end is not better. Due to the difficulty in obtaining such measures and given that the style construct is relatively young compared to ability, indirect measurements using ability tools to infer style are common and recognized by researchers (Frank, 1983; Messick, 1984; Widiger, Knudson, & Rorer, 1980; Witkin & Goodenough, 1981).

Not surprisingly, researchers disagree about the categorization of numerous cognitive constructs. For example, Jonassen and Grabowski (1993) only consider five constructs as cognitive styles (e.g., analytical-relational, leveling-sharpening, serial-holist, visual-haptic, and visualizer-verbalizer). They classifying seven other constructs, including FDI, as cognitive controls (see Table 2). Table 2 also shows alternative classifications for many of these constructs (Messick, 1984).

In light of these variations in construct labeling, key interrelationships among cognitive constructs (personality, mental abilities, cognitive styles, cognitive controls, learning styles, and cognitive strategies) are summarized below. Personality and mental abilities represent the core or foundation for the other constructs. Mental abilities are domain specific. Cognitive styles and cognitive controls are derived from both personality and mental abilities. Cognitive controls have a broad regulatory or control function and are closely associated with abilities. Cognitive styles provide both general control and organization and are more closely associated with personality. As such they are connected; alone they don't fully represent cognition. Learning styles and cognitive strategies are more likely to be influenced by the individual's experience and education

than the other constructs. In addition, cognitive or learning strategy selection may be a very conscious choice for the student.

Taken together these constructs provide a characteristic "feel" for an individual's information processing. For example, a different outcome is expected when taking an analytical rather than a global approach. Alternatively, if mental abilities of an individual are reduced due to a disease process, their interaction with others and the environment, and their information processing are likely to be compromised. In summary, cognitive constructs are more than just the sum of their parts, as they control and/or organize functioning within and across domains.

Table 2 highlights key cognitive constructs using the classification as provided by Jonassen and Grabowski (1993) and Messick (1984), and useful definitions. All of the publications relative to these constructs are dated since 1949 and provide an indication of the relative youth of this research arena.

Table 2

Cognitive Constructs and Definitions

Cognitive Construct	Classification		Definition
	(Jonassen & Grabowski, 1993)	(Messick, 1984)	
Automization	Control	Control	Ability to efficiently perform simple, repetitive tasks with a minimum of conscious effort.
Category Width (Breadth of Categorizing, Equivalence Range)	Control	Style	Tendency to use broad or narrow width classes when asked to categorize ideas or objects.
Cognitive Complexity-Simplicity	Control	Style	Tendency to use complex, multi-dimensional perceptual patterns rather than simple, single-dimension representations to differentiate, articulate, and integrate social and environment cues and facts.
Cognitive Tempo (Impulsivity-Reflection)	Control	Style	Tendency to delay and reflect on accuracy rather than provide an immediate answer when a response is requested.
Conceptual Style (Analytical-Relational)	Style	Control	Tendency to focus on details of an object rather than general attributes as the basis for a categorizing strategy.
Cognitive Flexibility (Constricted vs. Flexible Control)	Control	Control	Ability to resist distractions or contradictory cues to focus on relevant stimuli.
Field Dependence-Independence (Global vs. Articulated Style)	Control	Style	Degree to which perception is influenced by the surrounding field or framework.

Focal Attention (Scanning vs. Focusing)	Control	Style	Tendency to use broad and active rather than narrow and passive patterns for processing visual and verbal stimulus fields.
Leveling-Sharpening	Style	Style	Tendency to retain discrete details and images of successive visual or verbal stimuli.
Serialist-Holist	Style	Not addressed	Tendency to use broad, global strategy rather than an operational, chunk-type process to select and represent information.
Visual-Haptic	Style	Not addressed	Tendency to prefer visual rather than tactile interaction for processing information.
Visualizer-Verbalizer	Style	Not addressed	Tendency to prefer visual rather than text or verbal interaction for processing information.

Field Dependence/Independence - History and Measurement

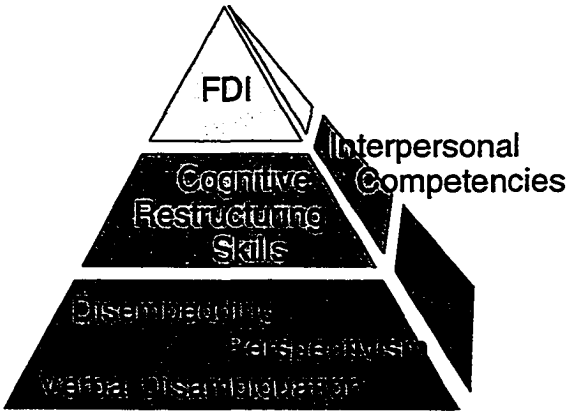
Of particular interest in the proposed study is the cognitive style "field dependence-field independence" (FDI) and the associated cognitive ability, cognitive restructuring. The foundation for the immense body of literature related to the cognitive style/control of FDI was provided by Herman Witkin and his colleagues. The dimension of FDI was initially introduced by Witkin and associates in the late 1940s. Witkin, in conjunction with colleagues, authored five books and over eighty articles related to FDI and psychological differentiation (Bertini, Pizzamiglio, & Wapner, 1986; Witkin & Goodenough, 1981). There are over 170 references in the 1977 review of FDI literature

by Witkin, Moore, Goodenough, and Cox and over 400 references in Witkin's final publication (Witkin & Goodenough, 1981).

In his last revision of FDI theory Witkin clarified his conceptualization of the relationship of FDI within the scheme of cognitive styles and abilities, by presenting a hierarchical cluster model which placed FDI at the apex as a cognitive style (Witkin & Goodenough, 1981). This dimension (see Figure 5) is also known as: autonomous functioning, autonomy of external referents, perception of the upright, reliance on vestibular-vs.-visual field referents, and articulated-vs.-global cognitive functioning (Witkin & Goodenough, 1981). This dimension was identified early in Witkin's research as he studied the perception of the upright in space using the Rod and Frame Test (RFT), Body Alignment Test (BAT) and the Rotating Room Test (RRT) (Witkin & Goodenough, 1981).

Figure 5

Witkin and Goodenough's Model for FDI



The second tier of Witkin & Goodenough's model (see Figure 5) accommodates cognitive abilities related to but not equivalent to the higher order "autonomy of external

referents" dimension. These abilities include but are not limited to cognitive restructuring and interpersonal competencies (Witkin & Goodenough, 1981).

Third order variables (see Figure 5) linked to cognitive restructuring included disembedding, perspectivism and verbal disambiguation (Witkin & Goodenough, 1981). Frank (1983) summarizes these skills

> as involving the abilities to (a) break up an organized field into its basic elements; (b) provide structure for an ambiguous stimulus complex; and (c) provide different organization to a field than that which is suggested from the inherent structure of the stimulus complex. (p. 90)

In addition to the tests mentioned previously (RFT, BAT, and RRT), FDI has frequently been measured using paper and pencil formats such as the Embedded Figures Test (EFT) (Witkin, Oltman, Raskin, & Karp, 1971), Group Embedded Figures Test (GEFT) (Witkin, Oltman, Raskin, & Karp, 1971), and Hidden Figures Test (HFT) (Ekstrom, French, Harman & Derman, 1976). These latter tools are considered tests of ability which have a high correlation with FDI. Additional tools are needed for extending FDI research; however, these represent the tools currently available. Witkin himself noted that "cognitive styles are thus conceived to express themselves in these abilities, and, accordingly, these abilities may serve as means for the assessment of cognitive styles." (Witkin & Goodenough, 1981, p. 60). Therefore using ability measures is a reasonable alternative for measuring style. Whether classified as a cognitive style or cognitive control, the impact of the FDI dimension is manifest at the cognitive ability level, and its value is as a predictive construct (D. H. Jonassen, personal communication, October 28, 1995).

Research - Field Dependence/Independence

There are several major features attributable to field dependence/independence cited throughout the FDI literature. The most frequently cited and relevant research findings are summarized in the following section.

Field Dependence/Independence - Learner Characteristics

According to a review of literature which addressed a wide range of cognitive constructs, Jonassen and Grabowski (1993) characterize FI learners with the following descriptors:

> analytical, generates structure, internally directed, inattentive to social cues, philosophical, cognitive, individualistic, distant in social relations, intrapersonal, reserved, aloof, experimental, generates own hypotheses, conceptually oriented, acquires information to fit conceptual scheme, represents concepts through analysis, less affected by format/structure, impersonal orientation, insensitive to social undercurrents, and ignores external stress. (p. 88)

They also summarized the FD learners:

> global, accepts structure, externally directed, attentive to social information, conflict resolvers, sociable and gregarious, affiliation oriented, interpersonal, need friendship, conventional, traditional, influenced by salient features, factually oriented, acquires unrelated facts, accepts ideas as presented, influenced by format/structure, gets feeling/decisions from others, sensitive to others, affected by stress. (p. 88)

Research related to FDI has found FI individuals are more autonomous (Witkin & Berry, 1975; Witkin, Moore, Goodenough, & Cox, 1977), less distracted by surroundings and tend to be more impersonal in social interactions (Pemberton, 1952). It is easier for FIs to disassemble and reassemble structured information and to assemble unstructured information (Moore, Gleser, & Warm, 1970; Nebelkopf & Dreyer, 1970; Stasz, Shavelson, Cox, & Moore, 1976; Witkin & Goodenough, 1981; Witkin, Moore, Goodenough, & Cox, 1977). As a result, FI individuals are considered more competent in cognitive restructuring skills. In specialized areas, such as science, mathematics, engineering, and architecture, FIs have also been shown to have a performance advantage over FDs (Annis, 1979; Carrier, Davidson, Higson, & Williams, 1984; Dubois & Cohen, 1970; Dwyer & Moore, 1992; Frank, 1983; Hunt & Randhawa, 1973; Witkin, Moore, Goodenough, & Cox, 1977).

Field Dependence/Independence - Learner Performance

The FDI construct is considered predictive of performance differences in some learner attention, encoding, short term and long term memory processes. This may be attributable to FI learners' preference for an analytical rather than global approach to perception, processing, and organization of information (Brown, 1987; Chinien & Boutin, 1993; Goodenough, 1986; Hsu, Frederick, & Chung, 1994; Witkin, Moore, Goodenough, & Cox, 1977; Witkin, Oltman, Raskin, & Karp, 1971). Other researchers have attributed these performance variations to learner efficiency in information processing (Davis, 1991; Marchionini, 1987). These findings are consistent with the cognitive ability of "cognitive restructuring" as proposed by Witkin and Goodenough (1981). Additional studies are described below.

In three studies, FIs were shown to be more vigilant in long duration monitoring of stimulus displays than FDs (Cahoon, 1970; Forbes & Barrett, 1978; Moore & Gross, 1973). Another study demonstrated that FDs made more errors than FIs in visual and auditory tasks which required participants to ignore competing, non-relevant stimulus while attending to relevant stimuli (Avolio, Alexander, Barrett, & Sterns, 1981).

In contrast to Goodenough's earlier findings of little relationship between FDI and associative learning and memory tasks (1976), Davis & Frank (1979) found differences in their studies using free recall. Specifically, FIs demonstrated improved recall when provided the chance to organize material; FIs tended to use more clustering strategies; and FIs demonstrated better recall of word lists organized in difficult patterns. In another study by Frank (1983), participants were asked to recall target words under three different conditions: (a) same cue; (b) different cue; and (c) free recall. FD participants performed significantly worse than those who were FI under the different cue recall condition, and FDs performance under different cue recall was significantly worse than either the same cue or free recall conditions. These findings supported Frank's hypothesis that rigid information processing by FD learners interferes with cue efficiency during memory recall (1983).

Annis (1979) observed that FI students learned and remembered text-based information better than FDs when structural importance was high. In a different study, FI students used prior information more frequently than FDs as a method to facilitate recall (Spiro & Tirre, 1980).

In evaluating performance on digit span tasks associated with short term memory processes, Berger and Goldberger (1979), found FIs had better recall on more difficult interference tasks, while FD and FI was not predictive for simpler registration tasks.

In explorations of working memory processes, FIs have shown faster, more accurate responses to high information load conditions. Performance under low information load conditions was similar for FD and FI individuals (Robinson & Bennick, 1978).

In contrast to FI individuals, FD individuals are more reliant on external sources of information (Solar, Davenport, & Bruehl, 1969; Linton, 1955), are more likely to be distracted by salient (prominent) and non-salient information in their surroundings and are more attentive to social cues, including verbal and non-verbal referents (Goodenough, 1976; Witkin & Goodenough, 1981). It is more difficult for FDs to disassemble and reassemble complex information with or without pre-existing structure (Moore, Gleser, & Warm, 1970; Nebelkopf & Dreyer, 1970; Stasz, Shavelson, Cox, & Moore, 1974; Witkin & Goodenough, 1981; Witkin, Moore, Goodenough, & Cox, 1977). In some subject areas, such as science and mathematics, FD's have a general performance disadvantage in comparison to FIs.

FD individuals have been found to "show more social behaviors and attributes important for effective interpersonal relations" (Witkin & Goodenough, 1981, p 45). FD's are characterized as "warm, affectionate, tactful, accommodating, nonevaluative and accepting of others, (and) not likely to express hostility directly against others" (Witkin & Goodenough, 1981, p 44). As a result, FD individuals are attracted to and excel in situations and occupations which focus on social interaction with others.

Field Dependence/Independence - Age, Gender, Culture

Age, gender and culture, whether considered singly or collectively, also influence the FDI dimension. As children age they are likely to become more FI (Witkin, Goodenough, & Karp, 1967), and men are more likely to be FI than women (Witkin, Moore, Goodenough, & Cox, 1977).

Societies which require independent functioning for survival (hunter-gatherer) and those which have "loose" social structure may be more likely to produce FI individuals (Pelto, 1968; Witkin & Berry, 1975). In contrast, societies which depend upon cooperation, compliance and sharing among members or those communities which have "tight" social structure may be more likely to produce FD individuals (Pelto, 1968; Witkin & Berry, 1975).

Field Dependence/Independence - Adult Professionals

For many years, occupational choice has been considered to be influenced by the FDI dimension (Witkin & Goodenough, 1981). For example, people in science, math, engineering, architecture, art and music careers tend to be FI. Many characteristics of the FI dimension (e.g., analytical, experimental, internally directed, and hypothesis generating) are likely to improve success in preparing for and performing in these professions. In contrast, FD individuals are more likely to select and succeed in professions (e.g., counseling, therapy, and psychiatry) which correspond with strengths in resolving conflicts, attention to social issues, well-developed interpersonal skills, and sensitivity to others (Fry & Charron, 1980; Quinlan & Blatt, 1972).

Review of FD and FI distribution within populations of practitioners in health and education careers support the findings cited above. The majority of professionals in health

careers related to analytical abilities (e.g., medical technology, surgical nursing, dental hygiene, and dentistry) are FI. People engaged in careers which emphasize therapy and counseling are predominately FD (Bamberg, 1981; Huntley & Goral, 1981; Linder, Janus, Bauer, & Dishman, 1991; Quinlan & Blatt, 1972).

A trend has also been identified within some professional health and education programs in which students shift from FD to FI between beginning and completing their formal education program (Bamberg, 1981; Morgan, Portis, Snyder, & Mills, 1995). This is supported by Witkin's discussion of the potential role of training and education in influencing the FDI dimension (Witkin & Goodenough, 1981).

Therefore, whether the differences between FD and FI individuals are associated with learning preferences, educational experiences, information processing skills (including cognitive restructuring), or other cognitive abilities, the importance is recognizing that these differences are often predictable and may significantly impact the performance of learners throughout their lifetimes.

Research - Hypertext and Field Dependence/Independence

A limited number of studies have explored relationships between the cognitive style (FDI) of the learner and their success in using hypertext systems for learning. A description of relevant studies follows.

In a study by Liu and Reed (1994), the researchers focused on learning strategies and preferences which field dependent and field independent learners demonstrated while using a hypermedia instructional system. FD students showed a pattern of higher frequency of use and more total time of use than FI students. In addition, FD learners favored video format, while preference for text and graphic formats were similar for both

groups. Lastly, FI learners were more likely to use only select components of the program, while FD learners used features which provided a more global perspective of the instructional content.

Leader and Klein (1994) approached their study of the FDI cognitive construct and interface tools by using four different treatments: all tools, browser, index/find, and map. The performance results of FI learners were significantly better than for the FD learners when using only index/find and map interface tools. However, when using all tools or the browser, performances for both groups were similar.

Additional studies have reported the impact of advanced or structural organizers on the performance of FD and FI learners when using hypertext and hypermedia systems. Weller, Repman, and Rooze (1994) found that FI learners outperformed FD learners for four different structural organizer combinations.

In another study Meng and Patty (1991) found illustrative organizers to be more beneficial than textual organizers. They also used organizer placement (e.g., advanced and post) to vary the experimental conditions. FD learners showed the most benefit from illustrative advanced organizers, while the FI learners, who consistently performed well, did not appear to make additional gains from use of organizers. A unique feature of this study was that a field-mixed, or intermediate category was used for participants who had a GEFT score within one-half standard deviation of the mean. This group demonstrated their best performance when provided with illustrative post-organizers. As a result, it appears that this field-mixed group may have unique needs that are not identified when their performance is incorporated into the results of either FD or FI learners.

In a study of cognitive style and computerized instruction, Abraham (1985) found that FD learners performed better using an example lesson. FI learners had better outcomes from a deductive lesson design.

Jonassen and Wang (1993) performed a series of three studies exploring the transfer of hypertext information structures to learner knowledge structures. One of these experiments included the FDI dimension as an independent variable. In addition to a short recall test, three measurement tools were developed to assess learners' structural knowledge based upon judgments about relationship proximity, semantic relationships, and analogies. Three treatments: a pop-up window requiring user feedback regarding semantic relationship between screens (generative), a pop-up window describing the semantic relationship between screens (supplantive), and an unstructured hypertext list (control) were utilized. The control group performed significantly better on recall tasks than the group using the generative treatment. FI learners scored higher on the recall tests under the generative and control conditions. On the semantic relationship scale, FI learners using the supplantive treatment scored better than those using the control and generative treatments.

In an exploratory study of information-seeking behaviors and learning, Small and Grabowski (1992) also included the FDI dimension as one of their independent variables. A summary of results included observations that FD individuals were more highly motivated toward the hypermedia technology than FI or field-mixed learners, and FI and field-mixed learners sought additional detail beyond that offered by the hypermedia system, while the FD learners were satisfied with the detail of existing hypermedia content.

From this review of research, it is apparent that success for FDs appear to be influenced by the degree of content structure in the hypertext instruction. On the other hand, FIs appear less influenced by content structure and benefit from providing their own organization to the content. These observations are compatible with cognitive restructuring skills and abilities, namely disembedding and reorganizing which are characteristic for FIs and more difficult for FDs.

What then is the interplay of the research areas discussed in this chapter? If the WWW is used by an institution to deliver continuing professional education to health care professionals, what are the most important questions to ask during initial implementation? Obviously, the effectiveness of educational WWW documents needs to be assessed. A number of questions arise. How can effectiveness be measured? How should effectiveness be measured? What aspects of effectiveness are critical to continuation of an educational program delivered via the Web? What aspects of effectiveness are critical to the design of HTML browsers and documents? What aspects of effectiveness are critical to revision of HTML browsers and documents?

Summary

The rapid growth and acceptance of the WWW as a communication medium since 1993 creates some dilemmas for educators. The popularity and high visibility of the Web does not ensure that it is an ideal instructional medium. However, decisions have been made by educational and commercial institutions to use it for instructional purposes.

Therefore, educators, particularly adult educators must prepare themselves and their students for the expected exponential growth of this new communications tool.

Global sharing of vast libraries of literature and data hold a tremendous potential for all learners. However, new skills and strategies will be required to access, navigate, and synthesize information from these massive stores of information. In addition, new social norms and pressures related to the use of the WWW have emerged in recent years in the United States. Media coverage of specific web sites and the exponential growth of the WWW has contributed to its high visibility.

Existing research addressing hypertext systems should provide a starting point for designing and evaluating HTML browsers and documents prepared for instructional use on the Web. Web browsers and course delivery tools have rapidly become more sophisticated and are challenging the functionality and features of existing proprietary hypertext systems (e.g., Authorware, Guide, and Hypercard).

One vein of hypertext research has revealed that the FDI construct may be predictive of learner success using hypertext systems. Structuring of and navigation through the information appear to be key areas where FI learners gain their advantage over FD learners.

Therefore, this study was proposed to broadly assess learners' success using WWW documents for educational purposes. If performance differences were apparent, further detailed investigations may be pursued. However, if performances were similar for FI and FD learners, then existing improvements to web navigational tools and content structure may provide both educational groups with instructional support and choices to allow them to customize instruction to their unique styles and needs.

Narrowing, or restricting the scope of this investigation early in the life cycle of web browsers and course delivery tools could render the results useless before the study is

completed. However, using this broader approach to assess the influence of cognitive style on learners' performance when using the WWW for CPE, should provide this researcher the opportunity to observe trends that have immediate impact and application to current distance education initiatives.

This study attempted to answer the following questions:

1. Do FD and FI learners differ in their ability to correctly answer multiple-choice questions drawn from the content of a web-based CPE module?
2. Do FD and FI learners differ in terms of rate of completion when using a web-based module (WebCT) for accessing CPE?
3. Do FD and FI learners differ in frequency of reporting a sense of "becoming lost" when using a web-based module (WebCT) for accessing CPE?
4. Do FD and FI learners differ in their navigation style when using a web-based module (WebCT) for accessing CPE?

CHAPTER III

METHODS

Introduction

This chapter describes methods and procedures used for this study. Sections are presented in the following order: research design, general hypotheses, selection and description of the sample, instruments, procedures for data collection, data analysis, limitations and summary.

Research Design

A deductive, quasi-experimental design was selected for this study. The objective was to gain an understanding of the relationship between the cognitive style field dependence/independence and the performance and completion success of health care professionals when using a web browser to access continuing professional education.

The dependent variables for this study were learner performance, learner completion, reported frequency of a sense of "becoming lost" and learner navigation style. Learner performance was measured using post-lesson and post-module examinations. Learner completion of the instructional module was determined by completion or non-completion of the post-lesson and post-module examinations. Post-lesson and post-module examinations were specific to the instructional content of the module and were validated through review and editing by three content specialists (experienced diagnostic medical sonography educators). Sense of "becoming lost" was measured using item 6 in the participant feedback survey. Classification of participant navigation style was based upon patterns used by participants when visiting lesson

content pages. Page tracking was accomplished through the management and monitoring features of the WebCT software. When a participant used more than one pattern, the investigator used the first pattern to represent the participant's initial navigational style.

The primary independent variables for this study was learner cognitive style of field independence or field dependence as measured by a computerized or paper and pencil form of the Hidden Figures Test (see Appendix E).

General Hypotheses

General hypotheses for this study were derived from research questions presented in Chapter 1. Each general hypothesis is presented in the null form.

H1 The scores of field independent and field dependent learners will not differ on multiple-choice questions drawn from the content of a web-based continuing professional education module.

H2 The completion rates of field independent and field dependent learners will not differ when using a web-based module (WebCT) for accessing continuing professional education.

H3 The reported frequency of a sense of "becoming lost" by field independent and field dependent learners will not differ when using a web-based module (WebCT) for accessing continuing professional education.

H4 The navigational styles of field independent and field dependent learners will not differ when using a web-based module (WebCT) for accessing continuing professional education.

Selection and Description of the Sample

Target Population and Sample

The target population for this study was health care professionals in the midwestern United States. The sample for this study was health care professionals, with an interest in quality assurance for ultrasound imaging equipment who registered for the educational module between January 4, and February 28, 1999. The sample of health care professionals were recruited from medical institutions in Oklahoma, the surrounding states, as well as other locations in North America and abroad, using print and electronic media as well as personal communications (Appendix A).

The target size for this non-random, opportunity sample of health care professionals was 100 or more learners. The majority of the learners were expected to be novice WWW users who were recruited to participate because of the unique content of this continuing professional education module.

Instruments

Hidden Figures Test

Primary independent variables, the cognitive styles of field dependence and field independence, were measured using the Hidden Figures Test (HFT). The HFT is a self-administered timed test which uses figures similar to those used on GEFT and EFT. It includes 32 items divided into two parts, with a time allotment of 12 minutes for each section. For each multiple-choice item, the individual is asked to select which one of five simple shapes is embedded within a more complex pattern. However, guessing is discouraged and a percentage of wrong answers is subtracted from the total number of

correct answers during the scoring process. The test is considered to have high reliability and good construct validity with the GEFT (range from 0.67 - 0.88). This tool is part of the Kit of Factor-Referenced Cognitive Tests available from Educational Testing Service (Ekstrom, French, Harman, & Derman, 1976).

A computerized web-version of the HFT was developed for use in this study. To evaluate its alternative form reliability with the paper and pencil test, both forms were administered to a subset of the target population. A more in depth discussion of the methodology and results for this test of reliability is located in the Appendix E1. The correlation between the computerized and paper and pencil forms of the HFT was r = 0.86, which is within acceptable parameters.

Performance Measures

Two of the dependent variables were scored based upon examinations learners encountered throughout the instructional module. **Learner performance** was measured using post-lesson and pre- and post-module examinations specific to instructional module content. These examinations were developed by the module author and reviewed by a panel of content specialists. **Learner completion** of the instructional unit was determined by completion or non-completion of all post-lesson and post-module examinations within a specified time frame. Sense of "becoming lost" was measured using item 6 on the participant feedback survey. Participant navigation style was based upon patterns used by participants when visiting lesson content pages.

Demographic Data and Situational Factors

A secondary set of independent variables included demographic data and occupational setting/context. These variables were included and measured to describe the

sample as well as to provide an opportunity to establish and control for their effects. The demographic data form, or registration survey, prepared by the researcher was generated using examples from previous studies, with the addition of situational factors which seemed pertinent to this study. Occupational setting/context were considered situational factors for the purposes of this study. The demographic data form included:

contact information: name, address, phone number, and email address;

demographic data: age, gender, marital and parental status and community size;

situational factors: characteristics of primary employer, employment hours, duties and responsibilities, area(s) of professional expertise, credentials, professional affiliations, CPE habits, computer experience and educational background.

Formative evaluation of the demographic data form was performed by educators in health care and adult education who were not included in the study sample.

Procedures for Data Collection

The population of health care professionals studied was recruited medical institutions in Oklahoma and the surrounding states, as well as from rural medical institutions participating in the Oklahoma Telemedicine Network (OTN). Participants were recruited using electronic (e-mail and webpages) and print publications (flyer and postcard) of the College of Allied Health, University of Oklahoma Health Sciences Center (Appendix A1). Additional recruiting was done via personal communications of the researcher with academic colleagues and organization administrators.

Administration of the Instruments

Potential participants were invited to visit a web page which provided introductory information, a link to questions and answers about the module, a link to the registration and consent form, a summary of expectations of participants, and a link for participants to login to the WebCT CPE module entitled "Sonography Quality Assurance Lessons" (see Appendix A1). This page continues to be available through the following web address (http://moon.ouhsc.edu/kboyce/CPE/).

Participants were required to electronically register to participate in the study prior to beginning the instructional module. As a part of the registration process the participant was asked to review the web page of questions and answers about the module (see Appendix A2), and complete and submit the registration survey and informed consent form (see Appendix A3). The survey and consent form are a single custom hypertext document which the participant completed and submitted electronically. Upon completion of the registration process, each participant received a unique username and password for accessing the instructional module via a web browser. Distribution of the username and password was primarily by email; however telephone, facsimile and regular mail were used as backup methods of communication.

At the time of registration, participants were notified of expectations of the study, which included completing a pre-module examination and a "Figures Test" (HFT) prior to beginning the lessons. The HFT was administered over the WWW using a custom HTML version of the test (Appendices E and H2). Test administration and scoring were modeled after the instructions described in the Manual for Kit of Factor-Referenced Cognitive Tests (Ekstrom, French, Harman & Dermen, 1976).

All participants who registered could access the instructional module after they received their unique username and password. Each lesson was supported by an online glossary of terms and an interactive image demonstration. There was one post-test for each lesson and one summative post-test at the end of the entire module. Each participant was allowed to complete each test only one time. A summative evaluation survey (feedback survey) was available at the website, and participants could complete it at any time during the instructional module. Participants were encouraged to wait until after they have completed the desired number of lessons before submitting the feedback survey. Email reminders and account extensions were sent to participants with minimal or no account activity in late January and mid-February, 1999. Participants who completed the two required surveys (registration and feedback survey), three required tests (pre-module, HFT, and post-module), the introductory lesson, one additional lesson, and corresponding post-lesson quizzes were eligible to receive approved CPE credits, at no additional cost. CPE credits were based upon the number of lessons and quizzes successfully completed. The minimum available was 1 CPE credit and the maximum was 3.5 CPE credits.

Data Collection

All data gathered via electronic means (surveys, pre-test, HFT, performance, and completion measures) were collected into electronic databases for storage and analysis. Additional data gathered by hand (i.e., paper version of HFT for alternative form reliability) were manually entered into an appropriate database.

The electronic database format permitted analysis using the Statistical Analysis System (SAS) software JMP IN and other analysis software (Microsoft Access, Microsoft Excel, and WebCT). WebCT was used to collect and analyze scores for the pretest,

posttest, and quizzes, as well as to track each time a learner accessed module content and lesson pages. Microsoft Access was used to collect and store information collected via web forms (i.e., registration survey, feedback survey, and HFT test). Microsoft Access databases were then converted into Microsoft Excel spreadsheets. These Excel spreadsheets were joined to allow simultaneous analysis of one or more data fields through the pivot table tool. Excel was also used to produce graphical representations of the data. Data from the Excel spreadsheets were copied into SAS JMP IN as necessary for inferential analyses of the study hypotheses. Use of this electronic format also made it easier to integrate data tabulations into presentation and publication software.

Rights of Human Subjects

Institutional Review Boards of the University of Oklahoma, at both Health Sciences Center and Norman campuses, reviewed the study and found it to be exempt from the requirements for full board review and approval prior to data collection (Appendix H1). Instructions in participant recruitment and registration documents informed the users of the study and guidelines for participation. Completion of the registration process (review of guidelines, and submission of registration survey and informed consent form) constituted a willingness to participate in the study.

All participant information was treated as confidential by the principal investigator. Data collected electronically via web-based forms were stored in password-protected databases, accessible by only the principal investigator and a computer network administrator. All electronic data were stored by field name separate from the data collection instruments. All information entered via text fields were stored in raw form. All other data were stored using abbreviations or numeric values which were meaningful

only when linked to the corresponding field name and instrument question. All printed copies of data were stored in lockable cabinets in a restricted area. Printed copies of raw and/or refined data will be shredded when the study and publications are completed. Password-secured electronic data will continue to be stored after study completion to permit comparison with similar data expected to be collected in future studies by the researcher. Publications which arise from this study will only report group and summary data, and no data will be distributed which could lead to identification of individual subjects.

To comply with the Society of Diagnostic Medical Sonographers (SDMS) policy for administering continuing medical education (CME) credits, participant names, addresses, registry numbers (if available), and number of CME credits earned were and will continue to be sent by mail to the SDMS Executive Office at regular intervals (Appendix H3). Otherwise, no individual data was or will be shared with vendors or organizations. This SDMS policy was designed to protect participants, education providers, and the SDMS from attempts to falsify CME credits. A summary of evaluative feedback from participants will also be forwarded to the SDMS Executive Office at the conclusion of this study to comply with its CME policy.

Continuing Medical Education (CME) certificates were sent to each participant by mail after all requirements were met. The CME certificate included participant name, registrant number (if available), name and number of CME module, end date of CME participation, and total number of CME physics specialty credits earned. It was at the discretion of each participant to select the professional organization(s) for submittal of CME certificates for credit.

Participants who wished to withdraw from the study were allowed to do so at any time without explanation or penalty. At the conclusion of the study, all participants will be notified by email or other means of the availability of a summary report.

Data Analysis

Data reduction and analysis were performed using the SAS JMP IN, Microsoft Access, Microsoft Excel, and WebCT. Descriptive analyses of the sample include frequency distribution, mean, median, standard deviation, standard error, range, sum, variance, and coefficient of variation for each major variable (Appendix G1).

Inferential analyses were done using multiple statistical approaches. The independent variable of field dependence/independence was treated as a categorical variable. Learner performance was analyzed as a continuous variable. Learner completion was analyzed as a categorical variable. As a result, analyses included both parametric and non-parametric tools. Causal-comparative analyses for hypothesis one were performed using t-tests. Chi-square analyses were used to analyze the data collected for hypotheses two, three, and four.

Limitations of Study

The generalizability of this study was limited by the sample population and cannot be extended to the population of all health care professionals. The results of this study were also limited due to:

(a) The size of the sample population,

(b) Lack of proctoring during web-based testing,

(c) Variability in participant computer skills,

(d) Variability in computer hardware and software used by participants,

(e) Participant prior knowledge of content,

(f) Participant reason or motivation for participating in study, and

(g) Participant attention and fatigue during participation.

Summary

A quasi-experimental design was used to investigate the questions addressed in this study. The non-random, opportunity sample for this study was drawn from health care professionals with an interest in quality assurance for ultrasound imaging equipment. Multiple measures of subject performance, demographics, and situational factors were made by means of web-based surveys, Hidden Figures Test, instructional lessons, and examinations.

Each web-based measure was automatically transmitted to a database for analysis using SAS JMP IN and other analysis software. Data analysis included descriptive analyses, predictive analyses using parametric and non-parametric tools, and causal-comparative analyses as appropriate.

Chapter IV

RESULTS

Introduction

This chapter begins with summaries of procedures followed and demographic data obtained in this study. Due to the number of participants who registered but did not complete the learning module by the cutoff date, demographic profiles are presented for both registrants and active participants. The chapter continues with presentation of results of data analysis. A summary will be provided at the conclusion of this chapter.

Summary of Procedures

Health care professionals from the surrounding states with an interest in sonography were recruited via electronic and print materials between January 4, 1999 and February 20, 1999. Potential participants were invited to visit a web page which provided introductory and computer information, a link to questions and answers about the module, a link to the registration and consent form, a summary of expectations of participants, and a link for participants to login to the WebCT CPE module. This page continues to be available through the following web address (http://moon.ouhsc.edu/kboyce/cpe/).

All participants who registered were sent a unique username and password within 72 hours of their submission. Email-based technical support was made available for participants with computer problems. Email notices and account extensions were sent to participants with minimal or no account activity in late January and mid-February, 1999. Some participants provided email notice of withdrawal from the study following these reminders.

Summary of Demographic Data and Situational Factors

A total of 114 health care professionals registered to participate in the study between January 6, 1999 and February 28, 1999. Summary data from the registration survey is included in Table 3 and Appendix A3. The registrant sample was predominately female (82.5%) and all were currently using ultrasound in a health care or educational setting. Registrants ranged in age from 20 to 64, with 28.1% less than 30 years of age. The marital status for this group was 64.9% married, 21.1% single, and 10.5% separated, divorced or widowed. Four registrants (3.5%) chose not to disclose their marital status. Twenty percent reported caring for preschool children, while 46.5% were responsible for older children.

Registrants lived in a variety of communities, from open country and small towns of less than 2,500 to urban centers with populations greater than one million. Most (70.1%) lived and worked in urban cities, while only 16.7% lived and worked in rural communities. The majority of this group (92.1%, n=105) indicated they resided in the United States. Of this group, 46.7% lived in Oklahoma, 31.4% resided in adjacent states of Texas, Kansas, Arkansas, Missouri, and Colorado. The remaining 21.9% were from 14 other states. Foreign registrants (n=9) were from Argentina, Australia, Canada, Israel, New Zealand, Romania, and the Ukraine.

Workplace settings for registrants showed considerable variation. Forty-three percent worked in hospitals with more than 100 beds, while only 6.1% (n=7) worked in hospitals with fewer than 50 beds. Private physician offices were workplaces for 21.9%, while outpatient clinics accounted for 20.2% of employment settings. Educational

programs accounted for 11.4% of workplace settings, while 8.8% of this group were affiliated with university medical centers; 7.9% were self-employed; 4.4% provided mobile services; 2.6% worked in a managed care setting; 1.8% were commercially employed; and 0.9% provided home health care.

Nearly 60 percent (59.6%) of registrants worked full-time. Full-time students represented 20.2% of this group, of which three also worked at least part-time. Only five registrants were part-time students. The majority of this group (69.3%) had five or more years of experience in their area of expertise. The same number of registrants (69.3%, n=79) held an American Registry of Diagnostic Medical Sonographers (ARDMS) credential in at least one area of sonography specialty (i.e., obstetrics/gynecology, abdomen, neurosonology, opthalmology, pediatric echocardiography, adult echocardiography, and/or vascular technology). The 30.7% without a sonography credential included at least 16 students.

Registrants reported a wide range of work-related duties. As noted earlier, all were currently using ultrasound in a health care or educational setting, with 90.3% involved in imaging three or more organ systems. Many in this group (43.9%) reported active engagement in other professional responsibilities such as: general radiography (18.4%), cardiac stress testing (11.4%), EKG/holter monitoring (9.6%), mammography (5.3%), nuclear medicine (2.6%), nursing (1.8 %), cardiovascular interventional technology (1.8%), radiation therapy (0.9%), and other (4.4 %). Registrants also reported a variety of other work duties which included: preparing and labeling film jackets/tapes (68.4%), retrieving and filing films/tapes (62.3%), transporting patients (57.2%), scheduling patients (56.1%), preparing reports (53.5%), processing film (49.1%), and teaching

students (42.1%). Fewer registrants reported collecting research data (30.1%), supervising department or other area (28.1%), quality control in other area (24.6%), billing (21.1%), processor quality control (14.9%), and other (9.6%).

Forty-three percent of registrants needed 10 or more CME credits at the time of registration, while 43.8% needed none. Most (67.5%) had attended at least one CME meeting in the past 12 months. Registrants indicated an interest in both traditional and contemporary delivery mechanisms for receiving CME. Most registrants (97.4%) have participated in formalized post high school education.

Fifty-four percent of this group had taken at least one computer class; 80.7% had more than one year of computer experience, and 79.9% had used the Internet more than five hours. Almost 80 percent (79.8%) used a computer at home, while 11.4% used a computer at a friend or relatives' home. Use of a computer at work was reported by 73.7% of registrants.

The following discussion will provide some additional demographic statistics about completers (n=37) and all test-takers (n=66) who were considered active participants. Some of these statistics are also presented in Table 3 to provide comparison to statistics for all registrants.

The sample of active participants was predominately female, 89.2% of completers and 86.45% of all test-takers. These participants ranged in age from 20 to 60, with 54.1% of completers being less than 30 years of age, while in the test-taker grouping this percentage drops to 34.8%. In comparison to all registrants, active participants were less likely to be married (48.6% / 57.6%); more likely to be single (35.1% / 28.8%); and fewer were separated, divorced or widowed (8.1% / 9.1%). A fewer active participants reported

caring for preschool children (10.8% / 13.6%) and having responsibility for older children (24.3% / 40.9%).

Table 3

Comparison of Completer, Test-Takers and All Registrants

Demographic and Situational Factors	Completers (n=37)	All Test-Takers (n= 66)	Registrants (n=114)
Female	89.2%	86.4%	82.5%
Male	10.8%	13.6%	17.5%
< 30 years old	54.1%	34.8%	28.1%
Married	48.6%	57.6%	64.9%
Single	35.1%	28.8%	21.1%
Separated, Divorced or Widowed	8.1%	9.1%	10.5%
Preschool children	10.8%	13.6%	20.2%
School-aged children	24.3%	40.9%	46.5%
Live and work in urban center	78.4%	75.8%	70.1%
Live and work in rural community	8.1%	13.7%	16.7%
Live in USA	97.3%	95.5%	92.1%
Live in Oklahoma	51.4%	42.4%	46.7%
Live in adjacent states	29.7%	34.8%	31.4%
Foreign resident	2.7%	4.5%	7.9%
Student, Full- or Part-time	56.8%	36.4%	20.2%
Needed 10 or more CME credits	29.7%	48.5%	43.0%

More of the completers and test-takers (78.4% / 75.8%) lived and worked in urban cities, while fewer lived and worked in rural communities (8.1% / 13.7%). The majority of these participants (97.3% / 95.5%) indicated they resided in the United States. Of this group, a large percentage lived in Oklahoma (51.4% / 42.4%), while many others resided in adjacent states (29.7% / 34.8%). Only one foreign registrant completed the module with a total of three in the test-takers grouping.

Of particular significance to interpretation of results of this study is that at least 56.8% of the completers were full-time or part-time students. This percentage drops to 36.4% of all test-takers. Finally, 29.7% of completers and 48.5% of test-takers needed 10 or more CME credits at the time of registration.

Results of the Data Analysis

A brief description of the data subset used is included within the summary of results for each hypothesis. Data analysis tools included WebCT, Microsoft Access, Microsoft Excel, and SAS JMP IN software.

A discussion of methodology and results for the alternate form validity/reliability pilot study for the computerized form of the Hidden Figures Test is located in Appendix E. The correlation between the computerized and paper and pencil form of the HFT was $r = 0.86$, which was within acceptable parameters. In accordance with scoring procedures recommended by Dr. Ruth Ekstrom, who developed and continues to manage the Hidden Figures Test (HFT) research for Educational Testing Service (personal communications, March 3, 1999), the grouping for the FDI variable was determined by taking the total group score range (-0.25 to 16.00) and dividing it into equal thirds. These divisions also

corresponded with natural breaks in the score range (see Figure E2 in Appendix E). This yielded three groups, the bottom third was labeled field dependent (FD), the middle third was labeled field mixed (FM), and the top third was labeled field independent (FI). A total of 45 of the 114 registered participants completed the HFT by March 6, 1999. Distributions by group were 40% FD (n=18), 26.7% FM (n=12), and 33.3% FI (n=15). Of these 45 participants, not all completed the module. Therefore, in order to maximize sample size, data subsets vary for each of the following hypotheses. With the exception of hypothesis one, all analyses are based on a $p < 0.05$.

Hypothesis One

H1 The scores of field independent and field dependent learners will not differ on multiple-choice questions drawn from the content of a web-based continuing professional education module.

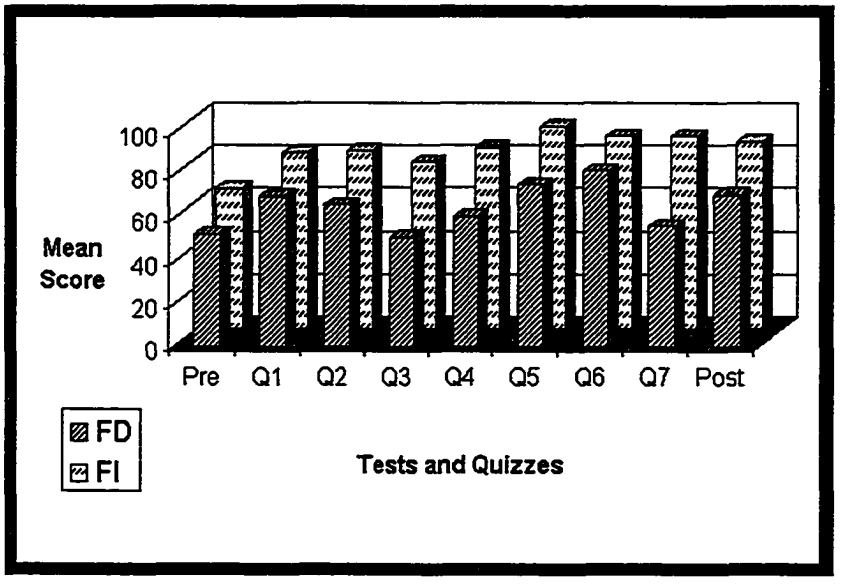
The initial evaluation of hypothesis one utilized t-test analyses performed using a subset of data for participants (n=22) who completed all tests and quizzes as well as the Hidden Figures Test. Figure 6 is a graphical comparison of score means by FD and FI groups for the pretest, quizzes, and posttest. Statistically significant differences in FI and FD group means for module quizzes 3, 4, 5, 7, and the posttest were detected at $p < 0.05$.

Because there was risk of a "familywise" Type I error occurring, due to relatedness of the measures from which the mean scores were drawn for evaluation by the t-tests, a simple conservative approach (Bonferroni correction) was taken to distributing the alpha across the multiple t-tests. The alpha was adjusted by dividing the original alpha (0.05) by the number of t-tests (9). This yielded an adjusted alpha of 0.0055 for assessing

the statistical significance of the nine t-tests. Using this conservative approach, group means for three quizzes (Quiz 3, Quiz 4, and Quiz 7) remained statistically significant.

Additional support for rejecting hypothesis one is provided by evaluating the practical significant difference in the group means for the quizzes. Given that a passing score of 70% was required to earn CME credit for each quiz, all FI group means exceeded those of the FD group (see Figure 6). All the FI group quiz means exceeded the 70% score, and only three of the FD group means reached or exceeded the 70% passing score. With these results there appears to be a performance disparity between the FI and FD groups.

Figure 6 - FD and FI Mean Scores by Test and Quiz



If a teacher was working with a group of students, where at least 25% (i.e., half of the FD group) was not likely or expected to achieve a passing score, this would be considered of practical significance, and the teacher would likely seek ways to improve the performance of this "at risk" group. It is on the basis of this performance disparity

relative to the passing score of 70% that a practical significant difference is proposed. This finding also provides further evidence to support the rejection of hypothesis one.

Quiz content corresponded to module lesson content. The pretest and posttest included items from all content areas. Quiz 1 covered the Introduction and Using a Phantom; Quiz 2 addressed Sensitivity; Quiz 3 covered Axial Resolution; Quiz 4 addressed Lateral Resolution; Quiz 5 dealt with Deadzone; Quiz 6 covered Vertical Caliper Accuracy; and Quiz 7 addressed Horizontal Caliper Accuracy.

The descriptive statistics and t-test analyses are summarized in Table 4. Additional descriptive statistics by FDI grouping for the pretest, quizzes, and posttest are available in Appendix G1 tables.

Table 4

Grand Table for Pretest, Posttest and Quizzes

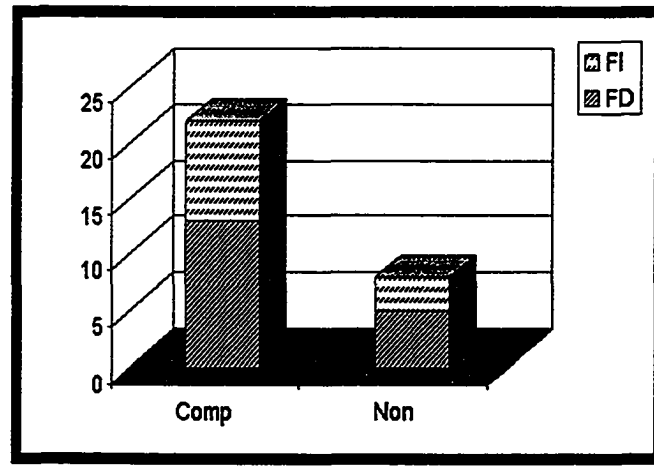
	Field Independence N=9		**Field Dependence** N=13		**t-test** original alpha = 0.05 adjusted alpha = 0.0055	
	Mean	SD	Mean	SD	t-test	p value
Pretest	65.56	21.28	52.31	17.39	-1.604	0.1243
Quiz 1	80.22	15.63	70.00	18.71	-1.607	0.1238
Quiz 2	83.33	14.14	66.15	24.34	-1.899	0.0721
Quiz 3	77.78	18.56	50.77	16.56	-3.582	0.0019
Quiz 4	84.44	12.36	60.77	12.56	-4.375	0.0003
Quiz 5	94.44	5.27	75.38	20.66	-2.689	0.0141
Quiz 6	90.00	8.66	81.54	16.25	-1.421	0.1706
Quiz 7	90.00	10.00	56.15	22.19	-4.262	0.0004
Posttest	87.22	9.39	70.77	14.41	-3.001	0.0071

Hypothesis Two

H2 The completion rates of field independent and field dependent learners will not differ when using a web-based module (WebCT) for accessing continuing professional education.

The second hypothesis was not rejected based upon a chi-square analysis. This analysis found no significant differences in FI and FD group number for the completers and non-completers (x^2 (1, 29) = 0.029, p = 0.8658). This analysis was performed using a subset of FD and FI participants who completed the module and the HFT (n=22) and those who didn't complete the module, but did complete the HFT (n=8). Figure 7 illustrates the number of FD and FI participants completing or not completing the module.

Figure 7 - FD and FI Counts for Completion and Non-Completion of Module



Analysis for this hypothesis used the non-parametric method of chi-square analysis. Table 5 provides a summary of the chi-square analysis for completion and non-completion of the module. The bottom of Table 5 shows the chi-square crosstabs table. The key for the crosstabs is in the top left cell.

Table 5 - Summary Chi-Square Analysis and Crosstabs for Hypothesis 2

Module Completion / Non-Completion by FD and FI

Source	**DF**	**-LogLikelihood**	**R Square (U)**
Model	1	0.014273	0.0007
Error	28	20.176077	
C Total	29	20.190350	
Total Count	30		
Test		**Chi-Square**	**Prob > ChiSquare**
Likelihood Ratio		0.029	0.8658
Pearson		0.028	0.8662
Count **Total %** **Expected** **Cell Chi-Square**	**Completion**	**Non-Completion**	
FD	13 43.33 13.20 0.0030	5 16.67 4.80 0.0083	18 60.00
FI	9 30.00 8.80 0.0045	3 10.00 3.20 0.0125	12 40.00
	22 73.33	8 26.67	30

Additional illustrations (Figures 8, and 9) also demonstrate the proportion of FD and FI participants beginning and completing the module remained uniform. Figure 10 summarizes the number of participants completing the quizzes. There was no dropout after completion of two quizzes.

Figure 8 - FD and FI Counts for Completion of Tests and Quizzes

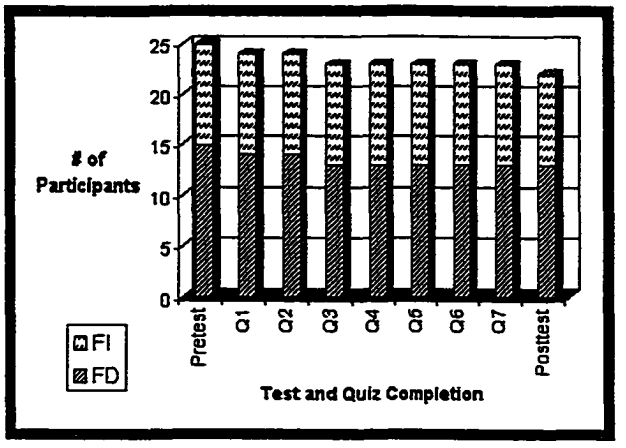


Figure 9 - FD and FI Percentages for Completion of Tests and Quizzes

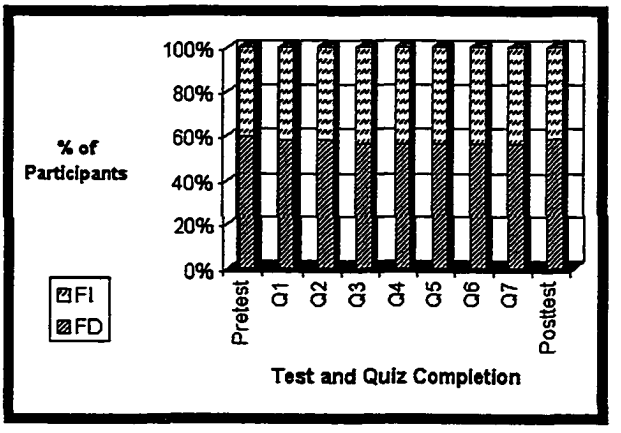
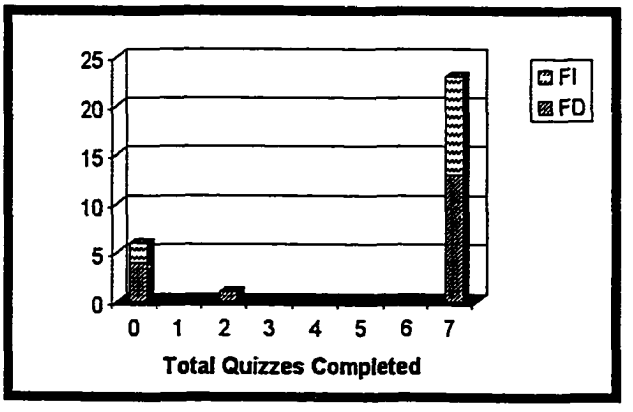


Figure 10 - FD and FI Counts for Total Number of Quizzes Completed

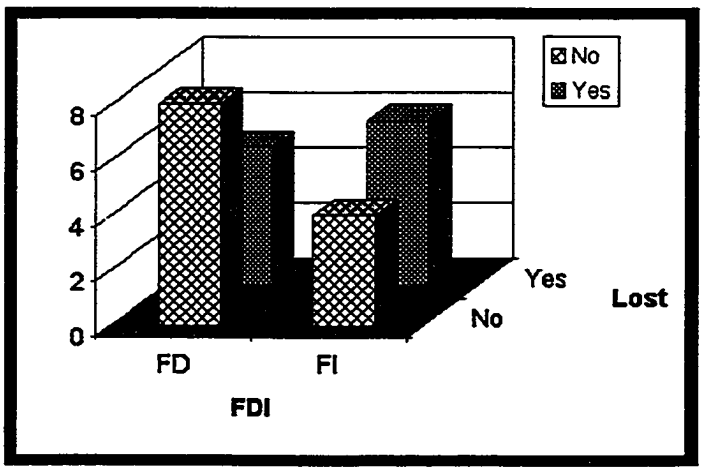


Hypothesis Three

H3 The reported frequency of a sense of 'becoming lost' by field independent and field dependent learners will not differ when using a web-based module (WebCT) for accessing continuing professional education.

The third hypothesis was not rejected based upon no significant differences in FI and FD group number for yes and no responses to the feedback survey question, "Did you ever have a sense of 'becoming lost' while using this module?" This chi-square analysis (x^2 (1, 22) = 1.058, p = 0.3037) was performed using the subset of participants who completed the Hidden Figures Test, the feedback survey, and belonged to the FD or FI groupings (n=23). As illustrated in Figure 11, FI participants were more likely than FD participants to report a sense of 'becoming lost'.

Figure 11 - FD and FI Counts for Sense of Becoming Lost



Evaluation of this hypothesis used the non-parametric method of chi-square analysis. Table 6 summarizes the chi-square analysis and the chi-square crosstabs.

Table 6 - Summary Chi-Square Analysis and Crosstabs for Hypothesis 3

FD and FI Groups by Lost

Source	**DF**	**-LogLikelihood**	**R Square (U)**
Model	1	0.528903	0.0336
Error	21	15.217272	
C Total	22	15.746174	
Total Count	23		
Test		**Chi-Square**	**Prob > ChiSquare**
Likelihood Ratio		1.058	0.3037
Pearson		1.051	0.3053
Count **Total %** **Expected** **Cell Chi-Square**	**No-Lost**	**Yes-Lost**	
FD	8 34.78 6.783 0.2185	5 21.74 6.217 0.2384	13 56.52
FI	4 17.39 5.217 0.2841	6 26.09 4.783 0.3099	10 43.48
	12 52.17	11 47.83	23

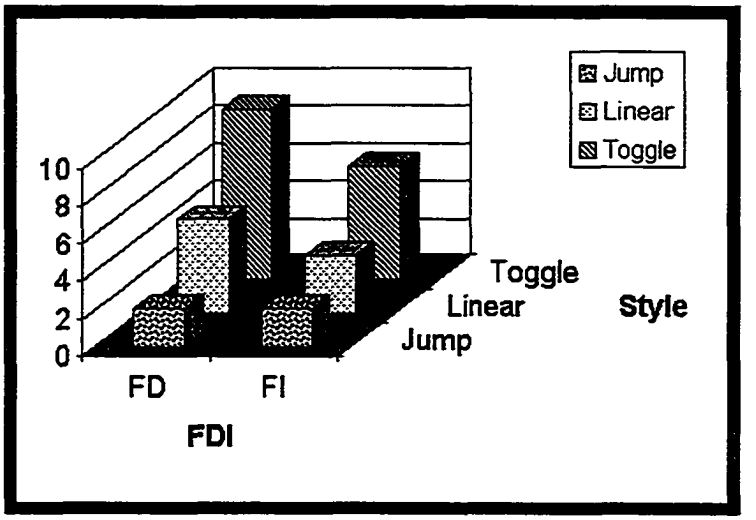
Hypothesis Four

H4 The navigational styles of field independent and field dependent learners will not differ when using a web-based module (WebCT) for accessing continuing professional education.

Analyses performed using the subset of participants who completed the Hidden Figures Test, visited at least two content pages, and belonged to the FD or FI groups

(n=27) were used to examine the fourth hypothesis. The chi-square analysis indicated no significant difference (x^2 (2, 26) = 0.178, p = 0.9148). Caution is necessary in interpreting this chi-square analysis since 20% of cells have expected counts of less than five. As illustrated in Figure 12, the proportion FD and FI participants using the three navigational styles of Jump, Linear, and Toggle are not noticeably different.

Figure 12 - FD and FI Counts for Navigational Style



The three navigational styles of Jump, Linear, and Toggle were identified by the investigator as patterns the participants used when visiting lesson content pages (see Table 7). Page tracking was accomplished through the management and monitoring features of the WebCT software. When a participant used more than one pattern, the investigator used the first pattern to represent the participant's initial navigational style. The Jump style was characterized by abrupt changes in lesson or resource selection from the linear hierarchy provided in the module. The Linear style represents participants

directly following the linear hierarchy of the module without backtracking. The Toggle style is demonstrated when a participant follows the linear module hierarchy but repeatedly backtracks. Examples of these navigational styles are provided in Table 7.

Table 7 - Examples of Three Navigational Styles

Access Sequence	Jump	Linear	Toggle
			L# = lesson number
1	L4 (Day 1)	L1 (Day 1)	L1 (Day 1)
2	L6	L2	L2
3	L7	L3	L1
4	QA Directions	L4	Navigation
5	L1	L5	Instructions
6	L3	L6	L1
7	L2 (later same day)	L7	L2
8	L3	QA Directions	L3
9	L4	QA Form	L2
10	L5	L1 (Day 2)	L3
11	L5	L2	L3
12	L1	L3	L2
13	L6	L4	L3
14	L7	L5	L4
15	QA Directions	L6	L5
16	L4	L7	L6
17		QA Directions	L5
18		QA Form	L6
19		QA Form (Day 3)	L5
20			L6
21			L7
22			L6
23			L7
24			L6
25			L7
26			QA Directions
			L1

Analysis for this hypothesis used the non-parametric method of chi-square analysis. Table 8 summarizes the chi-square analysis and crosstabs.

Table 8 - Summary Chi-Square Analysis and Crosstabs for Hypothesis 4

FD and FI Groups by Navigation Style

Source	DF	-LogLikelihood	R Square (U)
Model	2	0.089058	0.0049
Error	24	18.160270	
C Total	26	18.249328	
Total Count	27		

Test		Chi-Square	Prob > ChiSquare
Likelihood Ratio		0.178	0.9148
Pearson		0.180	0.9138

Count Total % Expected Cell Chi-Square	Jump	Linear	Toggle	
FD	2	5	9	16
	7.41	18.52	33.33	59.26
	2.37	4.74	8.89	
	0.0579	0.0142	0.0014	
FI	2	3	6	11
	7.41	11.11	22.22	40.74
	1.63	3.26	6.11	
	0.0842	0.0206	0.0020	
	4	8	15	27
	14.81	29.63	55.56	

Other Research Findings

A summary of data compiled from the Registration and Feedback Surveys are presented in Appendices A3 and F1. The methodology and results for the alternate form validity/reliability pilot study for the computerized form of the Hidden Figures Test are located in Appendix E.

Summary

The majority of registrants in this study were female, married, living and working full-time in an urban city in Oklahoma, Texas or Kansas. The majority of participants had at least 5 years of sonography experience and at least one specialty and credential with the American Registry of Diagnostic Medical Sonographers. All participants were actively involved in using ultrasound in a health care or educational setting, and most were responsible for imaging three or more organ systems. Many had other departmental responsibilities such as preparing and labeling film jackets/tapes, retrieving and filing films/tapes, transporting and scheduling patients, and preparing reports. Most had attended at least one continuing professional education meeting in the past 12 months and over 50% needed some CME credits at the time of registration. Nearly all participants had attended or completed formal post-high school education. Approximately 80% had more than one year of computer experience, used the Internet more than five hours, and used a computer at home.

Compared to the registrant profile, the typical participant who completed the module was more likely to be a student, less than 30 years of age, and less likely to be married or responsible for children. The typical completer was more likely to live and work in an urban city and reside in Oklahoma or a nearby state.

The first hypothesis, "The scores of field independent and field dependent learners will not differ on multiple-choice questions drawn from the content of a web-based continuing professional education module" was rejected. This was based upon significant differences in FI and FD group means for module quizzes at the $p = 0.0055$ level. They included Quiz 3 ($t = -3.582$, $p = 0.0019$), Quiz 4 ($t = -4.375$, $p = 0.0003$), and

Quiz 7 ($t = -4.262$, $p = 0.004$). This was also supported by a practical significant difference relative to the 70% passing score.

The second hypothesis, "The completion rates of field independent and field dependent learners will not differ when using a web-based module (WebCT) for accessing continuing professional education" was not rejected. This was based upon no significant differences in FI and FD group count for module completion/non-completion.

The third hypothesis, "The reported frequency of a sense of 'becoming lost' by field independent and field dependent learners will not differ when using a web-based module (WebCT) for accessing continuing professional education" was not rejected. This was based upon no significant differences in FI and FD group number for yes and no responses to the feedback survey question, "Did you ever have a sense of 'becoming lost' while using this module?"

The fourth hypothesis, "The navigational styles of field independent and field dependent learners will not differ when using a web-based module (WebCT) for accessing continuing professional education" was not rejected. This was based upon no significant differences in FI and FD group number for three navigational patterns (jump, linear, and toggle).

Chapter V

DISCUSSION

Introduction

This study was developed to gather evidence to support or reject the literature-based assumption that field dependent (FD) learners have a performance disadvantage compared to field independent (FI) learners when completing hypertext-based learning assignments. This study was performed in the context of continuing professional education using the World Wide Web as the distance education delivery mechanism. The educational provider would be characterized as a university/professional school according to Cervero's analysis (1988). The instructional module could be classified as hypermedia (text and still images) arranged as structured hypertext linkages in a knowledge presentation system according to previously discussed frameworks (Nelson, 1978; Nelson & Palumbo, 1992; Tolhurst, 1995). Participants included practicing clinical health care professionals (predominantly registered diagnostic medical sonographers and vascular technologists), sonography educators, and sonography students. This study also examined the research-based premise that reporting a sense of 'becoming lost' and/or navigational style correlates with learner classification along the field dependence/independence (FDI) continuum (Leader & Klein, 1994; Liu & Reed, 1994).

Summary of Major Findings

This study examined learning outcomes of health care professionals who participated in a continuing professional education module about quality assurance of diagnostic medical ultrasound equipment. The module was delivered via the World Wide

Web. Specifically, it investigated relationships between the cognitive style of FDI and each of the following: performance on module, module completion, frequency of a sense of 'becoming lost' while using the educational module, and navigational style in the module.

It was expected that FI participants would demonstrate higher levels of performance and module completion than the FD participants. It was also anticipated that FI participants would report fewer instances of a sense of 'becoming lost' than FD participants. FD participants were expected to use a linear navigational style more often than FI participants.

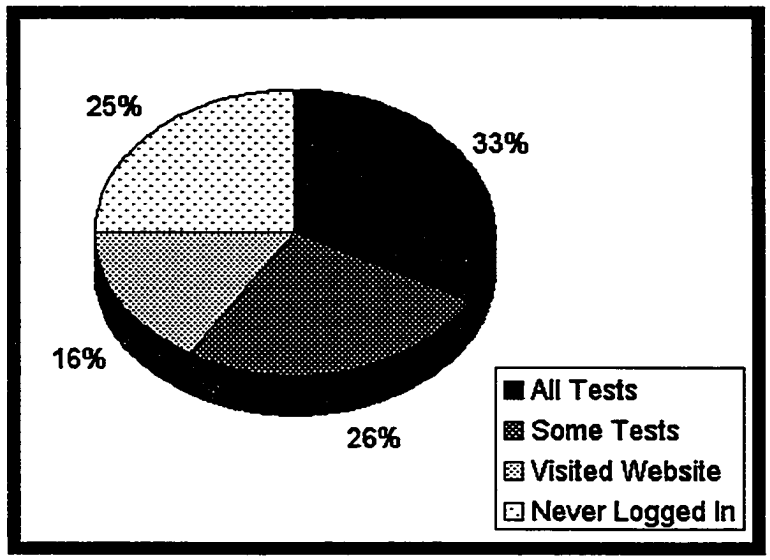
The Hidden Figures Test (HFT) was used to determine participants cognitive style along the field dependence/independence continuum. The paper version of this tool was adapted for use with web browsers. Appendix E addresses the methodology and results of the alternate HFT form reliability pilot study. Other electronic data collection tools included the web-based registration survey (Appendix A), feedback survey (Appendix F), pretest, posttest, and seven lesson quizzes (Appendix C).

The population of health care professionals studied were a non-random opportunity sample. Email and print solicitation targeted diagnostic medical sonographers and vascular technologists in Oklahoma and surrounding states. Email reminders were sent to registered participants who had minimal or no account activity as of late January and mid-February, 1999.

A total of 114 participants registered between January 6 and February 28, 1999. By March 6, 1999, thirty-three percent (n=37) completed the module; 25.4% (n=29) took

some tests but did not complete the module; 15.8% (n=18) accessed the website but did not take any tests; and 24.6% (n=28) never accessed the website (Figure 13).

Figure 13 Distribution of Levels of Participation in QA Module



Thirty-nine percent of participants (n=45) completed the HFT and 33.3% (n=38) completed the feedback survey. Twenty-nine percent (n=33) completed the module and the HFT, while 30.7% (n=35) completed the HFT and feedback survey. Eleven participants (9.6%) formally withdrew from the study. T-test analyses were used for hypothesis one, while chi-square analyses were performed on hypotheses two, three, and four.

Discussion of the Findings

This section will address the findings of each of the research questions. References to relevant appendices are included.

The first hypothesis tested the assumption that field independence would

correspond with higher scores on module performance measures (Witkin, Moore, Goodenough & Cox, 1977). The mean scores for the FI group exceeded those of the FD group for the pretest, posttest and all quizzes (Figure 6). The mean scores were statistically significantly different for Quiz 3, Quiz 4, Quiz 5, Quiz 7, and posttest at alpha = 0.05 and at alpha = 0.0055, Quiz 3, Quiz 4, and Quiz 7 remained statistically significantly different. As a result the null hypothesis was rejected. An additional argument to support the rejection of this hypothesis was based upon practical significance relative to the 70% passing score.

This variation in learner performance levels may reflect unique features of the instructional module used in this study. The first lesson was very global in design and included numerous embedded text and image examples which may have unintentionally provided additional support for FD learners. Use of example lessons was found by Abraham (1985) as beneficial for FD learners. In addition, others (Liu & Reed, 1994; Small & Grabowski, 1992) have found FD learners spent more time and were more motivated when using hypermedia. Since performance measures were not significantly different at the beginning of the module, participants may have had a higher level of attention at the beginning of the module and/or experienced a fatigue effect as additional lessons were completed.

Other research which supports the mean score variation demonstrated in this study is that of Robinson and Bennick (1978). They reported FI learners performing faster and more accurately in high information load conditions, while FD and FI learners demonstrated similar performance in low information load conditions. Perhaps the information load conditions were higher for those lessons and quizzes which showed the

most significant mean score differences and where learners were less familiar with the content of these lessons.

Certainly other factors such as variation in duration of studying each lesson, incentives tied to higher levels of performance, and variation in question difficulty may be additional important variables to consider. Review of the range of scores earned (Appendix G1) shows that maximum scores were earned by FD and FI learners for all quizzes except 1, 3, and 4. No learners earned a maximum score on the pretest and only FI learners earned the maximum score on the posttest. Only one learner (FD) failed all quizzes.

Additional caution should be used when interpreting these results because the majority of student participants were asked to participate in the module as an assignment. Due to the nature of the study, educators could not require students to provide their scores. Whether due to confusion with the WebCT interface, instructions or the desire to spend minimal time on this assignment, some students completed the module quizzes without reviewing the corresponding lessons. The extreme low scores earned on some of the quizzes lowered FD group mean scores. In addition, most students did not need to earn CME credits because they were not yet registered professionals, therefore achieving a minimum score of 70% was not necessarily a performance incentive for them.

The second hypothesis was developed from the assumption that field independence would correspond with a higher rate of module completion. The null hypothesis was not rejected because completion rates for FI and FD participants were equivalent. This is a hopeful result in that all groups demonstrated the capacity to complete the module. The ability to individualize the module navigation may well have

resulted in the higher than expected rate of completion among FD learners. This finding is supportive of the premise that WebCT is navigable for both FD and FI learners.

Caution must be used in interpreting this result because many participants were students who were directed to participate as an assignment. Therefore, there was an added incentive to complete the module. In fact, non-completion was not an option for many of these participants.

The third hypothesis was developed from the assumption that FD learners would report a higher rate of a sense of 'becoming lost' while engaged in the web-based module than FI learners. The null hypothesis was not rejected because group counts for reporting 'becoming lost' were not significantly different. In fact, FI learners had a higher rate of reporting a sense of 'becoming lost' than FD learners. This finding contradicts expectations that FD learners are most a risk for 'becoming lost' (Leader & Klein, 1994; Liu & Reed, 1994). This is an encouraging outcome which also supports the premise that WebCT allows multiple navigational styles and is navigable by FD and FI learners.

The fourth hypothesis was developed from the assumption that FD learners would demonstrate a higher rate of linear navigation while engaged in the web-based module than FI learners. The null hypothesis was not rejected because counts for three navigation styles (jump, linear, and toggle) were not significantly different for FD and FI learners.

This result suggests that within the web-based, hypertext environment provided by WebCT and the QA module, multiple navigational approaches are possible. This may be very important in meeting the varied needs of learners. Indeed, Leader and Klein (1985) documented similar performance for FD and FI learners when access to multiple navigational tools was made available. The results of this analysis do not reveal any trend

regarding learner success using the three navigation styles identified by the investigator. Secondary analysis of data gathered for hypothesis three and hypothesis four did not indicate a significant pattern of interaction among navigation, reports of 'becoming lost', and FDI.

Conclusions

Based upon the findings of this study, the following conclusions can be reached:

1. The cognitive style of FDI did not predict the level of learner performance on web-based quizzes for all of the sonography quality assurance content areas tested.
2. The cognitive style of FDI did not predict the likelihood of learner completion of a web-based educational module about sonography quality assurance.
3. The cognitive style of FDI did not predict the frequency of learners reporting a sense of 'becoming lost' while using a web-based educational module about sonography quality assurance.
4. The cognitive style of FDI did not predict the navigational style of learners using a web-based educational module about sonography quality assurance.
5. Findings and conclusions could not be generalized to the populations of health care professionals, diagnostic medical sonographers, or vascular technologists as a whole.
6. The majority of participants were registered diagnostic medical sonographers, registered vascular technologists, or sonography students. Therefore this study did not account for differences in those people practicing sonography and vascular technology who are not registered.

7. Registering to participate in a web-based educational module about sonography quality assurance did not predict participation or completion of the module.
8. The WebCT software as utilized for this web-based educational module about sonography quality assurance provided a navigable interface for learners throughout the FDI continuum.
9. The web-based HFT is a viable tool for assigning learners to an FDI category.

Implications for Educators

Despite the performance differences, both FI and FD learners were able to complete this educational module. Considering the potential benefits to learners offered by web-based continuing professional education (i.e., control of time, location, rate of instruction, duration and cost) this type of delivery should continue to be expanded. The following discussion is intended to provide practical suggestions for educators considering this education delivery mechanism.

1. Carefully consider the use of integrated web development, delivery, and tracking software, such as WebCT or similar products. They provide a broad palette of tools for the course author to select from in designing the course (i.e., chat, bulletin board, email, glossary, quiz, survey, and bookmark) which are "above and beyond" a simple content or lesson page. As a result, the costs and time required for additional specialized programming are reduced or eliminated.
2. Whether using an integrated software program or "home-grown" web pages, provide uniform navigational tools for learners. In this study, WebCT provided a consistent navigational interface through common icons, while apparently

providing flexibility for a variety of learner navigational styles (linear, toggle, and jump). This approach to design allows learners to benefit from familiarity in the structure across multiple lessons and may allow them to transfer navigational strategies across courses. This design approach also allows the authors and designers to apply flexible and efficient use of templates across a variety of content areas.

3. Determining web browser compatibility is important from both a technical and learner support perspective. There are a variety of programming languages used to add interactive features to integrated web course software and stand-alone web pages (i.e., ActiveX, CGI, and JavaScript). Unfortunately, web browsers are not uniform in their ability to interpret these languages. This requires testing of all web pages and web-based forms in all versions of each browser which you intend to support. Failure to address this issue prior to implementation is likely to disrupt course delivery and student access. In fact, it should be addressed early in the design process to ensure functionality. For example, Microsoft Internet Explorer 3.0 (aka. AOL 3.0) supported ActiveX, but not JavaScript. As a result, it was incompatible with some interactive functions of WebCT which required JavaScript. On the other hand, if programming of the HFT timer had been done using ActiveX, Netscape Navigator 3.0 would have been rendered incompatible since it did not support this control language. Newer versions of browsers recognize more languages, but problems still exist. Some learners are also not comfortable with installing newer browser versions. Others may be using the latest beta version, which may also be a source of unsuspected errors. It is critical

to provide learners with a listing of browsers and versions which have been successfully tested with the educational module and related web pages. If special control settings are required for proper operation within any browser (i.e., enable JavaScript), step-by-step instructions should be provided for the learners, so they can change or verify these settings.

4. Most importantly, consider your audience. What are your assumptions about their general and computer literacy, computer and Internet availability, motivation to participate or even their categorization relative to FDI? These are some of the factors which should be taken into consideration during module design. For example, as a result of this study, I am likely to encourage learners to complete no more than two lessons per online session to reduce the potential impact of fatigue on their performance. Additionally, in future modules, I plan to incorporate social activities or "virtual community" events (i.e., scheduled chat sessions), to provide a venue in which FD learners may excel based on their information processing preferences.

5. Consider using the web-based HFT locally or remotely to identify "at-risk" learners within your populations of interest. Alternatively, there may be other tools which are relevant for identifying groups within your population who are "at risk" for poor performance. As an educator, it is your responsibility to try to identify and develop strategies to help raise their level of performance.

6. Encourage your institution to establish a mechanism for providing support for learners. This includes providing resources for managing registration and CPE credit verification. Some providers have chosen to automate these processes;

however, this may be cost prohibitive for small projects. Automated CPE credit verification has also been vulnerable to fraud (i.e., printing out multiple web-based CME forms with the name changed). Technical support for learners should minimally include an email address for submitting questions and readily updated "Frequently Asked Questions" (FAQs) web page which is easily accessed by learners.

Implications for Researchers

The rapid expansion of the World Wide Web also provides a wide vista for research inquiries, beyond the obvious role of serving as a repository for research findings. The following discussion will provide some guidance for researchers considering online data collection and/or investigating online educational experiences of learners.

1. Electronic data collection is a beneficial way to use technology to assist in data gathering for research protocols. For example, the use of a web-based form (i.e., survey or tool) may be used for both local and remote administration. This approach provides advantages for researchers and participants by increasing the flexibility of administration sites and times. The need for proctoring or timed test administration may limit the applicability of electronic data collection. However, even these problems may be overcome through on-site proctoring and timed web-form submission as was used in this study for the HFT Alternate Form Reliability Study (Appendix E).
2. Just as there are a variety of programming language concerns for educational design and delivery, the same issues pose problems for online data collection.

Web browser software is notorious for incompatibilities with a variety of programming languages. This is gradually being addressed through new browser versions; however, the rate of new browser adoption lags behind these advancements. This lag is due to both low user comfort with downloading and installing a new version and the high rate of significant programming bugs and security holes in newly-released versions. Therefore, it is critical to test the functionality of all web pages and web-forms in multiple versions of each browser which may be used for data collection. Failure to perform this testing prior to implementation is likely to disrupt data collection and may lead to loss of data during submission.

3. Establish a clear profile of your target population. Who are you really interested in reaching in your study? In this study, the original target population was rural health care practitioners and as a result the focus was on the largely rural, midwestern geographic region of the United States. If you are interested in more generalizable results, consider using a relevant national mailing list from which to draw a random sample. Consider the structure of the employment worksite when selecting a relevant mailing list. In this study, attempts to reach rural sonographers through the rural medical centers were minimally successful. Many of them were employed by a third-party mobile company which provided services for multiple rural medical sites. As a result, it became evident that direct mail to sonographers in the region would be a more successful strategy for recruitment of participants into the study.

4. Define participation at the onset of the study design. Given the high rate of

post-registration attrition in this study, this issue becomes critical during planning. What will constitute "active" participation? Is viewing a lesson adequate, or is the completion of an assignment or test required? Given the 40% attrition in this study, what sample sizes will be adequate to meet the needs of your study?

5. A surprising trend emerged in the reporting of a sense of "becoming lost". The FI learners reported becoming lost more frequently than the FD group. This is contrary to research findings of Leader and Klein (1994) and Liu and Reed (1994). Further investigation of this question is particularly relevant for researchers interested in online learners. In this study, FI and FD learners may have defined "becoming lost" differently. FD learners may have been "desensitized" to the sensation of becoming lost, because it was commonplace for them. Alternatively, FI learners may have become more disoriented in this particular module while they were altering their pre-existing information seeking patterns.

6. Preliminary analyses in this study also included the field-mixed (FM) group (Appendix E). Consistent with findings by Liu and Reed (1994) and Meng and Patty (1991), the performance of the FM group did not consistently represent at intermediate between the FI and FD groups. Therefore, the FDI variable is better treated as a categorical variable, rather than as a continuous variable. Research projects which include the FI and FD groupings should also include the less studied FM group. To allow comparison of results, scoring and group classification should be consistent with procedures recommended by the Educational Testing Service (Appendix E).

Recommendations

Based upon results of this study, several administrative and research recommendations can be made. These recommendations are outlined in the following section.

Administrative Recommendations

1. Continue to develop and strengthen relationships with rural medical centers to enhance opportunities for delivery of continuing professional education to these organizations. This will probably require a greater number and variety of modules in order to get and retain the attention of supervisors and participation of the health care professionals.
2. Email distribution lists need to be created to improve efficiency in reaching rural health care professionals. Guidance in setting up and using email accounts, and tutorials on use and setup of web browsers appear to be needed at this time.
3. Formative evaluation of new modules is necessary to minimize technical problems. This includes testing modules on a variety of web browsers. Technical problems appear to deter some learners from continued participation. Therefore, technical support/suggestions should be readily accessible for all participants.
4. Feedback opportunities should be provided for all web-based modules (whether using WebCT or another web-based interface) to gather information about participant experiences. Participant suggestions for module modification should be evaluated and implemented as appropriate.

Future Research

1. Data collection begun for this study should be continued to broaden the sample and increase the total numbers of participants. This would permit more robust analyses and segregation of student subject data from clinical sonographer subject data. Since development of the module is already complete, further investment should focus on website and registration maintenance and additional data analyses.
2. Data already collected should be exploited through further analyses. This includes extracting a more detailed profile of participants, from those who completed the module to those who withdrew or never logged into the website. Other analyses could explore the characteristics of FD learners with very high and very low scores on performance measures. The relationship between navigational style and frequency of reporting a sense of 'becoming lost' should also be explored in more detail.
3. Feedback opportunities should be provided for all web-based modules (whether using WebCT or another web-based interface) to gather information about participant navigation. Page tracking features should be used when available.
4. Other studies could address the following research areas:
    a. Expanding testing of web-based HFT with other populations.
    b. Replicating the study design with other populations and educational content.
    c. Exploring factors which contribute to non-participation after module registration.

d. Exploring factors which contribute to rapid module completion.

e. Exploring the impact of fixed time lines for module completion and other incentives on module completion.

With the rapid growth of web-based educational offerings in a seemingly unlimited range of content areas, further exploration of relationships between learner characteristics and their learning outcomes continues to be a viable and relevant research arena.

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Appendix A

Registration Materials

Appendix A1

Invitation to Participate

Sonography Quality Assurance Lessons

Announcing a Free CME Module for Sonographers !

Welcome!
(See new notes below to avoid computer problems).

Please visit the Invitation to Participate webpage at:
http://alliedntweb.ouhsc.edu:100/public/cpe1001/
Encourage others to register so they can also earn free CME.

Computer Recommendations:

Special note to AOL Users: I don't have access to an AOL account or browser. However, **please attempt to enable frames, Java, Javascript** and **turn off alerts for web forms and cookies.** I think this will help resolve some of the problems AOL users have reported.

The QA webpages have been tested on the following frame-enabled web browsers:

- Netscape Navigator Version 3.01 (No reported problems)
- Netscape Communicator Version 4.05 & 4.07 (No reported problems)
- Internet Explorer Version 4.0+ (Some problems reported of browser locking up when submitting results.
  Figures Test, Interactive Demo, Feedback Survey & some links which open new windows will have to be maximized to be used).

Please make sure that alerts for submitting web forms and cookies are turned off (you should turn them back on when you are done with the module, as they interfere with submission of the tests and surveys).

- In Netscape 3.01, click through Options ... Security Preferences ... General tab... unselect "Submitting a Form Insecurely". and click through Options ... Network Preferences ... Protocols tab... unselect "Show alert before accepting a cookie".
- In Netscape 4.05, click through Edit ... Preferences ... to Advanced (Accept All Cookies should be checked and Warn me before accepting a cookie SHOULD NOT be checked).
- In Internet Explorer 4.0, click through View ... Internet Options ... to Security tab (check Low, do not warn...) and go to Advanced tab... under Cookies, select "Always accept cookies".

Please make sure Java & Javascript features of your web browser are enabled. Location of Java controls is listed below.

- In Netscape 3.01, click through Options ... Network Preferences ... to Language (last tab).
- In Netscape 4.05, click through Edit ... Preferences ... to Advanced (Java & Javascript checkboxes on main panel).
- In Internet Explorer 4.0, click through View ... Internet Options ... to Advanced

  (check Java JIT compiler enabled).

Recommended computer monitor settings to optimize display of the interactive demos and Figures Test are listed below.

- 800 x 600 resolution, 256 to millions of colors, and small to medium fonts.
- 1024 x 768 resolution, 256 to millions of colors, and small to large fonts.

In Windows 95 or 98, click through Start ... Settings ... Control Panel ... to Display icon. Click on Settings tab to change Desktop Area (Resolution), Color Palette (Number of Colors), and Font Size. Depending upon your software version, there may be a Display icon on the Task Bar adjacent to the Clock (this allows the user to quickly select among multiple display resolution & color settings).

Send e-mail to me at: kari-boyce@ouhsc.edu
Or reach me by phone at: (405) 271-2288

Last updated by Kari Boyce on February 1, 1999

Sonography Quality Assurance Lessons

Invitation to Participate and Learn

To learn more about quality assurance (QA) procedures used in Diagnostic Medical Sonography, please follow the links #1 & #2. This project is part of an educational research study. Before you can access the seven QA lessons and interactive demos, you will need to allow 20 minutes to complete the following:

1. Review **"Questions I Want Answered Before Registering"**
2. **Registration [We're back up as of 3 pm, Jan 20, 1999]**
   (including mailing address, e-mail address, and demographic information)

When you complete the registration form, your browser will automatically go to a web page which outlines the recommended sequence of events and a login button.

A unique username and password will be sent to you within 48 hours after you submit a completed registration survey and consent form. This will allow you to access the web-based pretest, lessons, demos, quizzes, posttest, and feedback survey for a period of 30 days. In addition, you will be expected to complete a web-based figures test which assesses your ability to find and match shapes.

You may access the lessons one at a time or in multiples. The lesson about using a phantom is required, otherwise lesson sequence is suggested but not required. A hypertext glossary is provided for learning new terms. An interactive demo is available for each lesson. Quality assurance procedures and sample QA report forms are printable for use in your ultrasound lab.

Please forward questions about this QA project, additional related websites and other messages to
kari-boyce@ouhsc.edu

Sonography Quality Assurance Lessons

Bookmark this page !
Return here when you receive your username and password.

Your unique username and password will be sent within 48 hours. This will allow you to access the lessons, demos, quizzes, surveys and tests for a period of 30 days.

Please use the following sequence to ensure you complete each requirement:

1. If you have already completed the Registration Survey and Informed Consent Form,
2. Please wait to receive username and password by email, phone or mail.
3. Then return to this web page to Login to the QA website.
4. To login, type in your username on the first line and password on the second line.
5. Follow screen directions to begin the Pretest.
6. Take Pretest before you begin any lessons (10 minutes).
7. Next take Figures Test to assess your ability to find and match shapes (30 minutes).
8. Complete introductory lesson (Using a Phantom), explore related demos and take corresponding quiz (35 minutes).
9. Complete at least one other lesson, demo, and corresponding quiz (35 minutes each).
    - Sensitivity Lesson, Demo, and Quiz
    - Axial Resolution Lesson, Demos, and Quiz
    - Lateral Resolution Lesson, Demos, and Quiz
    - Deadzone Lesson, Demo, and Quiz
    - Vertical Caliper Accuracy Lesson, Demo, and Quiz
    - Horizontal Caliper Accuracy Lesson, Demo, and Quiz
10. Take Posttest after completing all lessons you intend to use (10 minutes).
11. Complete Feedback Survey when you are ready to receive your CME certificate (10 minutes).
12. CME certificate will be sent to you by mail after completion of requirements has been verified.

[Login] [Cancel]

Sonography Quality Assurance Lessons

Invitation to Participate in Educational Research Study

- **I am seeking health professionals from Oklahoma to participate in an educational research study.**
- **Participants should be currently performing exams in the areas of:**
  - **sonography,**
  - **echocardiography, and/or**
  - **vascular technology.**
- **The study will require approximately 65 minutes of your time at a computer lab at the University of Oklahoma Health Sciences Center.**
- **There is no compensation for this first hour of participation.**
- **If you choose to invest additional time (less than 5 hours) in using the corresponding web-based educational module during the following 30 days, you can earn up to 3.5 CME at no additional cost.**
- **If you do not have access to a computer, I will help arrange temporary computer access for you to complete the module.**

- **For your convenience, I have coordinated some research sessions with the upcoming Clinical Educator's Meeting for the Sonography Program at the College of Allied Health (6:30 - 8:00 pm in CHB 144).**
- **If you are willing to participate in this study on the evening of Thursday, January 28, 1999, please call (405) 271-2288 and make a reservation for one of the following times:**
  - **5:30 pm - 6:35 pm (prior to Clinical Educator's Meeting)**
  - **6:50 pm - 7:55 pm (during Clinical Educator's Meeting - for participants not affiliated with the Sonography Program)**
  - **8:10 pm - 9:15 pm (after Clinical Educator's Meeting)**
- **Please also indicate your intention to attend the Clinical Educator's Meeting, as a light meal and beverages will be provided at that meeting.**
- **Parking will be available adjacent to the building (Lot A).**
- **Additional information regarding location and directions will be provided after you make your reservation to participate.**

If you would like to learn more about participating in this research study, please go to the Invitation to Participate web page at:
http://moon.ouhsc.edu/kboyce/cpe/

OR

Send e-mail to me at: kari-boyce@ouhsc.edu
You may also reach me by phone at: (405) 271-2288

If you are interested in participating, but cannot come to the Health Sciences Center, please register at the web page listed above to participate entirely via computer.

Encourage your colleagues to register so they can also earn free CME.

Appendix A2

Questions and Answers About the Module

Sonography Quality Assurance Lessons

Questions I Want Answered Before Registering

- **What is quality assurance (QA)?**

  A group of procedures used to assess the accuracy and uniformity of equipment, performance, procedures and processes in healthcare and a variety of other industries. In sonography, this includes (but not limited to) evaluating the accuracy of measurements and the ability of the equipment to resolve and display small targets.

- **Why should I perform quality assurance procedures?**

  As a sonographer, your equipment serves as your window into the body. Therefore, it is to your advantage to know the strengths and limitations of the equipment you are using. QA also identifies changes in your equipment before you might recognize it on clinical images. In addition, voluntary laboratory accreditation requires documentation of periodic QA testing.

- **Our equipment service contract includes quarterly QA testing, so I don't need to bother, right?**

  Periodic preventative maintenance (PM) and QA testing is very important. However, if a transducer were dropped the day after a "PM visit", how would you evaluate it to see if it was damaged? If you know appropriate QA procedures, you could test the transducer, and make a comparison to previous QA test results in a matter of minutes.

  These procedures are also useful for obtaining a practical estimation of how well equipment performs at various gain, power or depth settings. Repeating QA procedures at different transducer frequencies provides an estimate of tissue penetration at typical and maximum power levels. This information may help you determine the best frequencies or transducers for various examinations.

- **How do I earn CME credits from this website?**

  This website is part of an educational research project. To encourage your participation, CME credits are currently being offered at no cost.

  In addition to successfully completing the introductory lesson and quiz (Using a Phantom) and at least one other lesson and corresponding quiz (worth 1.0 CME), you are required to complete two surveys and three tests within 30 days of registration to be eligible for the free CME. These include:

  1. **Registration Survey and Informed Consent**
  2. **Pretest**
  3. **Figures Test**
  4. **Posttest**
  5. **Feedback Survey**

  You will receive 0.5 CME credit for each lesson and

corresponding quiz you successfully complete. The maximum CME currently available for each person is 3.5 CME credits. You may access the lessons one at a time or in multiples. After completing the introductory lesson about using a phantom, the lesson sequence is suggested but not required. Interactive image demos are available for each lesson and a hypertext glossary is provided for learning new terminology. Quality assurance procedures and a sample QA report form are printable for use in your ultrasound lab.

CME certificates will be sent to each participant by mail after all requirements are met.

Any attempt to submit bogus or fake data will disqualify your participation and access to this website will be denied.

- What are the learning objectives for the QA lessons?

  After completing the QA lessons you should be able to successfully complete the following objectives. Your performance will be assessed using corresponding quizzes.

  1. Identify which filament group(s) to use for each QA test.
  2. Identify equipment control settings and transducer characteristics which influence QA test results.
  3. Demonstrate measurement procedures for each QA test.
  4. Calculate percentage error and compare to acceptable error for each QA test.
  5. Select specified images from a group of QA test images.
  6. Describe several reasons to perform periodic QA testing in sonography labs.

- **How will the survey and test data be used?**

  This data is being gathered for educational research

purposes. The goal is to better understand how health professionals learn and to identify the strengths and weaknesses of using the World Wide Web to deliver continuing professional education.

Publications which arise from this project will only report group and summary data. No participant will be personally identified and all individual data will be treated as confidential by the researcher.

To comply with the Society of Diagnostic Medical Sonographers (SDMS) policy for administering continuing medical education (CME) credits, participant names, addresses, registry numbers (if available), and number of CME credits earned each month will be sent by mail to the SDMS Executive Office by the researcher. Otherwise, no individual data will be shared with vendors or organizations. This SDMS policy is designed to protect participants, education providers, and the SDMS from attempts to falsify CME credits. A summary of evaluative feedback from participants will also be forwarded to the SDMS Executive Office at the conclusion of this study to comply with their CME policy.

CME certificates will be sent to each participant by mail after all requirements are met. It is at the discretion of each participant as to which professional organization(s) they submit their CME certificates for credit. At the conclusion of the study all participants will be personally notified by email or other means of the availability of a summary report of this study.

- **I'm ready to participate, what do I do next?**

After you complete the registration survey you will receive a unique username and password (sent within 48 hours) which will allow you to access the lessons, demos, quizzes, surveys and tests for a period of 30 days.

Please use the following sequence to ensure you complete each requirement:

1. **Registration Survey and Informed Consent Form**
2. **Wait to receive username and password by email, phone or mail.**
3. **Login to website, your username and password will provide access.**
4. **Pretest, before you begin any lessons.**
5. **Figures Test, to assess your ability to find and match shapes.**
6. **Lessons and Quizzes**
7. **Posttest, only after completing all lessons you intend to use.**
8. **Feedback Survey**
9. **CME certificate will be sent to you by mail.**

- **Who do I contact if I have additional questions regarding this project?**

  Please forward questions about this QA project, additional related websites and other messages to *kari-boyce@ouhsc.edu*

Go directly to Registration Survey

Appendix A3

Registration Survey, Consent Form,

and Registration Survey Results Summary

Sonography Quality Assurance Lessons

Registration Survey Results

1. Your Email Address

2. Your First Name

3. Your Last Name

4. Street Address

5. City

6. State Abbreviation

Results for Item 6: (% based on 105 USA Participants)

Oklahoma and Surrounding States	**Other States**
OK = 49, 46.7%	CA = 4, 3.8%
TX = 18, 17.1%	NY = 3, 2.9%
KS = 12, 11.4%	AZ = 2, 1.9%
AR = 1, 0.9%	OH = 2, 1.9%
CO= 1, 0.9%	PA = 2, 1.9%
MO = 1, 0.9%	WI = 2, 1.9%
	MI = 1, 0.9%
	MN = 1, 0.9%
	MS = 1, 0.9%
	NC = 1, 0.9%
	ND = 1, 0.9%
	NV = 1, 0.9%
	TN = 1, 0.9%
	WA = 1, 0.9%
	WI = 1, 0.9%

7. County

8. Zip Code

9. Country

Results for Item 9: (n = 114)

USA = 105, 92.1%
non-USA = 9, 7.9%

10a. **Your Home Phone**

10b. **Your Work Phone**

11. **Your Registry Number** (if applicable) Please type both number and name of organization for each registry.

12. **Your Age**

Results for Item 12: (n = 114)

Age range = 20 - 64 years
Age mean = 36.4 years
4, 3.5% = Blank
27, 23.7% = 20 - 29 years
42, 36.8% = 30 - 39 years
33, 28.9% = 40 - 49 years
6, 5.3% = 50 - 59 years
2, 1.8% = 60 or more years

13. **Your Gender**

Results for Item 13: (n = 114)

94, 82.5% = Female
20, 17.5% = Male

14. Your Marital Status

Results for Item 14: (n = 114)

24, 21.1% = Single
74, 64.9% = Married
12, 10.5% = Separate, Divorced, or Widowed

15. Are you currently responsible for parenting any preschool aged children?

Results for Item 15: (n = 114)

87, 76.3% = No
23, 20.2% = Yes

16. Are you currently responsible for parenting any school aged children?

Results for Item 16: (n = 114)

57, 50.0% = No
53, 46.5% = Yes

17. Describe the population of the community you live in?

Results for Item 17: (n = 114)

4, 3.5% = Rural - Open country or farm
3, 2.6% = Rural - Small town (under 2,500)
7, 6.1% = Rural - Town (2,500 - 9,999)
17, 14.9% = Rural - Small city (10,000 - 49,999)
19, 16.7% = Urban - Medium city (50,000 to 99,999) or adjacent sut
26, 22.8% = Urban - City (100,000 to 249,999) or adjacent suburb
19, 16.7% = Urban - Large city (250,000 to 999,999) or adjacent sut
17, 14.9% = Urban - Metropolis (greater than one million) or adjacer

18. Describe the population of the community you work in?

Results for Item 18: (n = 114)

0 = Rural - Open country or farm
0 = Rural - Small town (under 2,500)
2, 1.8% = Rural - Town (2,500 - 9,999)
17, 14.9% = Rural - Small city (10,000 - 49,999)
14, 12.3% = Urban - Medium city (50,000 to 99,999) or adjacent sut
13, 11.4% = Urban - City (100,000 to 249,999) or adjacent suburb
22, 19.3% = Urban - Large city (250,000 to 999,999) or adjacent sut
16, 14.0% = Urban - Metropolis (greater than one million) or adjacer

19. **Describe The Healthcare Facility Where You Are Employed.**

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 19: (n = 114)

- ☐ 1, 0.9% = Hospital - less than 20 beds
- ☐ 6, 5.3% = Hospital - 20 to 50 beds
- ☐ 49, 43.0% = Hospital - more than 100 beds
- ☐ 23, 20.2% = Outpatient Clinic
- ☐ 3, 2.6% = Managed Care (HMO, PPO, etc)
- ☐ 25, 21.9% = Private Physician's Office
- ☐ 5, 4.4% = Mobile Imaging Service
- ☐ 1, 0.9% = Home Health Service
- ☐ 10, 8.8% = University Medical Center
- ☐ 13, 11.4% = Education Program
- ☐ 2, 1.8% = Manufacturing or Commercial Organization
- ☐ 9, 7.9% = Self-employed
- ☐ 1, 0.9% = Not employed in healthcare
- ☐ 1, 0.9% = Unemployed
- ☐ 23, 20.2% = Other: Full-time student
- ☐ 5, 4.4% = Other: Part-time student
- ☐ 0 = Other

20. **What ultrasound duties have you performed over the past 12 months?**

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 20: (n = 114)

- ☐ 94, 82.5% = Abdominal imaging
- ☐ 95, 83.3% = Pelvic imaging
- ☐ 90, 78.9% = Obstetrical imaging
- ☐ 45, 39.5% = Adult cardiac imaging
- ☐ 18, 15.8% = Pediatric cardiac imaging
- ☐ 72, 63.2% = Peripheral vascular imaging
- ☐ 47, 41.2% = Cerebrovascular imaging
- ☐ 64, 56.1% = Abdominal vascular imaging
- ☐ 40, 35.1% = Neurosonography
- ☐ 4, 3.5% = Ophthalmologic imaging
- ☐ 0 = Ophthalmologic biometry
- ☐ 82, 71.9% = Doppler
- ☐ 83, 72.8% = Transvaginal imaging
- ☐ 23, 20.2% = Transrectal imaging
- ☐ 25, 21.9% = Transesophageal imaging
- ☐ 13, 11.4% = Other
- ☐ 1, 0.9% = None

21. **Have you had professional responsibilities in any of the following areas over the past 12 months?**

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 21: (n = 114)

- ☐21, 18.4% = General Radiography
- ☐CT/MRI (Invalid data due to coding error)
- ☐6, 5.3% = Mammography
- ☐2, 1.8% = Cardiovascular Interventional Technology
- ☐3, 2.6% = Nuclear Medicine
- ☐1, 0.9% = Radiation Therapy
- ☐0 = Respiratory Therapy
- ☐0 = Physical Therapy
- ☐0 = Occupational Therapy
- ☐13, 11.4% = Cardiac Stress Testing
- ☐11, 9.6% = EKG/Holter Monitoring
- ☐2, 1.8% = Nursing Care
- ☐5, 4.4% = Other
- ☐64, 56.1% = None + Blank

22. **What additional duties have you performed over the past 12 months?**

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 22: (n = 114)

- ☐ 64, 56.1% = Scheduling patients
- ☐ 65, 57.2% = Transporting patients
- ☐ 61, 53.5% = Preparing reports
- ☐ 78, 68.4% = Preparing/labeling film jackets/tapes
- ☐ 71, 62.3% = Retrieving and filing films/tapes
- ☐ 24, 21.1% = Billing
- ☐ 56, 49.1% = Film processing / darkroom
- ☐ 17, 14.9% = Processor quality control
- ☐ 28, 24.6% = Quality control in other area
- ☐ 32, 28.1% = Supervision of department or area
- ☐ 48, 42.1% = Teaching students
- ☐ 35, 30.1% = Collecting research data
- ☐ 11, 9.6% = Other
- ☐ 7, 6.2% = None + Blank

23. **What are your employment hours?** (For the past 12 months)

Results for Item 23: (n = 114)

68, 59.6% = Full time (at least 35 hours/week)
20, 17.5% = Part time (between 20 to 35 hours/week)
12, 10.5% = Part time (less than 20 hours/week)
7, 6.1% = Unemployed
6, 5.3% = Other

24. **How Many Others at Your Institution Have the Same Position Description as You?**

☐ **Results for Item 24:** (n = 114)

Range = 0 to 16 positions
10, 8.8% = NA
9, 7.9% = Blank
35, 30.7% = 0 positions
51, 44.7% = 1 - 5 positions
7, 6.1% = 6 - 10 positions
2, 1.8% = 16 positions

25. **Describe Your Area of Healthcare Expertise.**

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 25: (n = 114)

☐95, 83.3% = Sonography
☐38, 33.3% = Echocardiography
☐48, 42.1% = Vascular Technology
☐37, 32.5% = Radiography
☐2, 1.8% = Nuclear Medicine
☐1, 0.9% = Radiation Therapy
☐2, 1.8% = Respiratory Therapy
☐0 = Physical Therapy
☐0 = Occupational Therapy
☐5, 4.4% = EKG Tech
☐2, 1.8% = Nursing
☐ 5, 4.4% = Physician
☐1, 0.9% = Other
☐ 2, 1.8% = None

26. **Indicate your years of experience in MAIN area of expertise selected in previous question.**

☐

Results for Item 26: (n = 114)

Range = 0 to 32 years
Mean = 8 years
6, 5.3% = Blank
35, 30.7% = less than 5 years
18, 15.8%% = 5 - 10 years
41, 36.0%% = 11 - 20 years
19, 16.6%% = more than 21 years

27. **What are your professional credentials?**

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 27: (n = 114)

- ☐ 51, 44.7% = RDMS Abdomen
- ☐ 62, 54.4% = RDMS OB/GYN
- ☐ 12, 10.5% = RDMS Neurosonology
- ☐ 1, 0.9% = RDMS Ophthalmology
- ☐ 0 = ROUB Ophthalmic Biometry
- ☐ 25, 21.9% = RDCS Adult Cardiac
- ☐ 5, 4.4% = RDCS Pediatric Cardiac
- ☐ 30, 26.3% = RVT Vascular Technology
- ☐ 45, 39.5% = RT General Radiography
- ☐ 1, 0.9% = RT CT/MRI
- ☐ 4, 3.5% = RT Mammography
- ☐ , 0.9% = RT Cardiovascular Interventional Technology 1
- ☐ 1, 0.9% = RT Nuclear Medicine
- ☐ 1, 0.9% = CNMT Nuclear Medicine
- ☐ 1, 0.9% = RT Radiation Therapist
- ☐ 2, 1.8% = Respiratory Therapist
- ☐ 0 = Physical Therapist
- ☐ 0 = Occupational Therapist
- ☐ 2, 1.8% = EKG Tech
- ☐ 0 = Nurse - LPN
- ☐ 1, 0.9% = Nurse - RN
- ☐ 4, 3.5% = Physician
- ☐ 8, 7.0% = Other
- ☐ 23, 20.2% = None + Blank

28. To What Professional Groups Do You Belong?

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 28: (n = 114)

☐12, 10.5% = Local Area Radiologic
☐38, 33.3% = Local Area Sonographic / Echocardiographic /
☐ 8, 7.0% = Local Area Other Professional
☐8, 7.0% = State Radiologic
☐11, 9.6% = State Sonographic / Echocardiographic / Vascul
☐5, 4.4% = State Other Professional
☐16, 14.0% = National / Regional Radiologic
☐67, 58.8% = National / Regional Sonographic / Echocardiog Vascular
☐7, 6.1% = National / Regional Other Professional
☐5, 4.4% = International Professional
☐5, 4.4% = Other
☐22, 19.3% = None + Blank

29. Describe your attendance at continuing professional education events in the past 12 months.

Results for Item 29: (n = 114)

21, 18.4% = Did not attend any events
13, 11.4% = I wanted to attend but was unable due to other obligatic
21, 18.4% = Attended one event
19, 16.7% = Attended two events
13, 11.4% = Attended three events
24, 21.1% = Attended four or more events

30. **How many continuing education credits (hours) do you need in the next 12 months to maintain your professional credentials?**

Results for Item 30: (n = 114)

Range = 0 to 40 hours
9, 7.9% = NA
9, 7.9% = Blank
32, 28.1% = 0 hours
5, 4.4% = 1 - 4 hours
32, 28.1% = 5 - 10 hours
17, 14.9% = 11 - 20 hours
10, 8.8% = 21 - 40 hours

31. **Describe your current preference for continuing professional education opportunities.**

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 31: (n = 114)

☐69, 60.5% = Local area professional society meetings
☐28, 24.6% = State professional society meetings
☐49, 43.0% = National / Regional professional society meetin
☐9, 7.9% = International professional society meetings
☐35, 30.7 = Specialty conference hosted by professional socie
☐38, 33.3% = Specialty conference hosted by educational insti
☐23, 20.2% = Specialty conference hosted by commercial ven
☐53, 46.5% = Professional / medical journals
☐16, 14.0% = Professional / medical books
☐37, 32.5% = Video tapes
☐13, 11.4% = Audio cassette tapes
☐23, 20.2% = Mail order lessons
☐52, 45.6% = Computer-based lessons
☐63, 55.3% = Web-based lessons
☐28, 24.6% = Discussions with other health care professionals
☐5, 4.4% = Other
☐5, 4.4% = Blank

32. Describe Your Experience Using Computers.

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 32: (n = 114)

☐ 5, 4.4% = Other
☐ 84, 73.7% = Use computer(s) at work
☐ 91, 79.8% = Use computer(s) at home
☐ 13, 11.4% = Use computer(s) at friend or relatives home
☐ 21, 18.4% = Have used computers less than one year
☐ 14, 12.3% = Have used computers for 1 to 2 years
☐ 78, 68.4% = Have used computers for 3 or more years
☐ 62, 54.4% = Have had one or more computer classes
☐ 52, 45.6% = Have not had any computer classes
☐ 9, 7.9% = Have used the Internet less than 5 hours
☐ 19, 16.7% = Have used the Internet between 5 and 20 hours
☐ 72, 63.2% = Have used the Internet more than 20 hours
☐ 1, 0.8% = Do not use computers

33. What is your highest level of earned education?

Results for Item 33: (n = 114)

0 = did not graduate from High School
3, 2.6% = High School Diploma or GED
23, 20.2% = Some College or Vocational Education Courses
8, 7.0% = Vocational Education Program
26, 22.8% = Two year College Degree
31, 27.2% = Four year College Degree
5, 4.4% = Some Graduate Courses
11, 9.6% = Graduate Degree
7, 6.1% = Doctoral Degree

Consent to Participate in Web-Based Research Study University of Oklahoma - Norman Campus University of Oklahoma - Health Sciences Center	
Title of Research Study:	Delivering Continuing Professional Education at a Distance: The Correlation of Field Dependence/Inpendence and Learning Using the World Wide Web
Researcher Contact Information:	Kari Boyce, M.Ed., RDMS, RDCS Send email to *kari-boyce@ouhsc.edu* or phone (405) 271-2288 Graduate Student in Adult and Higher Education, College of Education University of Oklahoma-Norman Campus Office of Research Administration University of Oklahoma-Norman Campus Send email to *djennings@ou.edu* or phone (405) 325-4757
Purpose of Research:	The purpose of this research study is to determine if learner cognitive style of field dependence/independence is predictive of success when participating in web-based continuing professional education.
Procedures:	Participants in this study are expected to complete each of the following: (timeframes are approximate). 1. **Registration Survey and Consent Form,** 15 minutes or less to complete and submit. 2. **Username and password** will be sent within 48 hours by email, phone or mail. 3. **Login to website,** your username and password will provide access. 4. **Pretest,** 10 minutes or less to complete and submit. 5. **Figures Test,** 30 minutes to review instructions, complete, and submit two-part test. 6. **Lessons and Quizzes,** a minimum of 30 minutes for each lesson and 5 minutes for each quiz.

	7. **Posttest,** 10 minutes or less to complete and submit. 8. **Feedback Survey,** 10 minutes to complete and submit. 9. **CME certificate** will be sent by mail when all requirements are completed.
Risks:	There are no known mental or physical risks involved in this study. Computer access to the Internet is the responsibility of the participant. The recommended web browsers are Netscape 3.0+ or Internet Explorer 3.0+.
Benefits:	Participants in this study will benefit by access to information contained in each lesson and in the supporting materials including the demos, glossary, and printable forms. Additional personal benefit in the form of CME credit is dependent upon the number of lessons successfully completed by the participant and completion of required tests and surveys. There are no penalties for not participating. At the conclusion of the study all participants will be personally notified by email or other means of the availability of a summary report of this study.
Compensation:	Compensation for participating in this study is 0.5 CME for each lesson and corresponding quiz successfully completed by the participant. These CME credits are being offered to participants free of charge. **Prior to receiving a CME certificate by mail, the participant must minimally complete two required surveys, three required tests, the introductory lesson (Using a Phantom) and one other lesson.** There are no penalties for not participating in this study.
	All participant information will be treated as confidential by the researcher. Publications which arise from this study will only report group and summary data, and no participant will be personally identified. To comply with the Society of Diagnostic Medical Sonographers (SDMS) policy for administering continuing medical education (CME) credits, participant names, addresses, registry numbers (if available), and number of CME credits earned each month will be sent by mail to the SDMS Executive

Confidentiality:	Office by the researcher. Otherwise, no individual data will be shared with vendors or organizations. This SDMS policy is designed to protect participants, education providers, and the SDMS from attempts to falsify CME credits. A summary of evaluative feedback from participants will also be forwarded to the SDMS Executive Office at the conclusion of this study to comply with their CME policy. CME certificates will be sent to each participant by mail after all requirements are met. It is at the discretion of each participant as to which professional organization(s) they submit their CME certificates for credit.
Freedom to Withdraw:	Participants who wish to withdraw from the study may do so at any time without explanation or penalty.
Participant Approval:	I have read and understand the Informed Consent and conditions of this study. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this study. If I participate, I may withdraw at any time without penalty. I agree to abide by the rules of this study. I acknowledge that I am between 18 and 65 years of age. **Submission of this registration form is acknowledgement of my consent.**

Note: Please print this page NOW for later reference, BEFORE pressing the submit button.

SUBMIT REGISTRATION and CONSENT

Last updated by Kari Boyce on November 30, 1998

Appendix A4

Notification Form

Kari E. Boyce

Subject: Sonography QA Lesson Notification/Welcome

Sonography Quality Assurance Lessons-Username/Password Notification
Welcome!

Your username/LoginID is:
Your password is:
(both are lowercase)

Please return to: http://alliedntweb.ouhsc.edu:100/public/cpe1001/#bookmark
Then go to the bottom of the page to LOGIN to 'Sonography Quality Assurance' module.

Please treat your username/LoginID and password as confidential.
Only you can earn free CME when logging in with your username/LoginID.
Do not share it with anyone else.

Your account will be active for 30 days.

Computer Recommendations:

Special note to AOL Users:
I don't have access to an AOL account or browser. However, please attempt to **enable frames, Java, Javascript** and **turn off alerts for web forms and cookies.** I think this will help resolve some of the problems AOL users have reported.

The QA webpages have been tested on the following frame-enabled web browsers:

- Netscape Navigator Version 3.01(No reported problems)
- Netscape Communicator Version 4.05 & 4.07 (No reported problems)
- Internet Explorer Version 4.0 (Some reported problems with locking up when submitting results and using links. The Figures Test, Interactive Demo & Feedback Survey & some links which open new windows may have to be maximized to be used).

Please make sure that alerts for submitting web forms and cookies are turned off (you should turn them back on when you are done with the module, as they interfere with submission of the tests and surveys).

- In Netscape 3.01, click through Options ... Security Preferences ... General tab... unselect "Submitting a Form Insecurely". and click through Options ... Network Preferences ... Protocols tab... unselect "Show alert before accepting a cookie".
- In Netscape 4.05, click through Edit ... Preferences ... to Advanced (Accept All Cookies should be checked and Warn me before accepting a cookie SHOULD NOT be checked).
- In Internet Explorer 4.0, click through View ... Internet Options ... to Security tab (check Low, do not warn...) and go to Advanced tab... under Cookies, select "Always accept cookies".

Please make sure Java & Javascript features of your web browser are enabled. Location of Java controls is listed below.

- In Netscape 3.01, click through Options ... Network Preferences ... to Language (last tab).
- In Netscape 4.05, click through Edit ... Preferences ... to Advanced (Java & Javascript checkboxes on main panel).

- In Internet Explorer 4.0, click through View ... Internet Options ... to Advanced (check Java JIT compiler enabled).

Recommended computer monitor settings to optimize display of the interactive demos and Figures Test are listed below.

- 800 x 600 resolution, 256 to millions of colors, and small to medium fonts.
- 1024 x 768 resolution, 256 to millions of colors, and small to large fonts.

In Windows 95 or 98, click through Start ... Settings ... Control Panel ... to Display icon. Click on Settings tab to change
Desktop Area (Resolution), Color Palette (Number of Colors), and Font Size. Depending upon your software version, there
may be a Display icon on the Task Bar adjacent to the Clock (this allows the user to quickly select among multiple display
resolution & color settings).

Please direct others to the Invitation to Participate webpage at:
http://moon.ouhsc.edu/kboyce/cpe/
Encourage others to register so they can also earn free CME.

Send e-mail to me at: kari-boyce@ouhsc.edu
Or reach me by phone at: (405) 271-2288

Appendix B

Sonography Quality Assurance Lessons

Appendix B1

Opening Screen

Welcome to the Sonography Quality Assurance Continuing Education Module

This module has been approved by SDMS for CME credit.

Tests & Quizzes

Figures Test

Course Content

Interactive Demos

Start Where You Left Off

Feedback Survey

To encourage your participation, CME credits will be offered at no cost. Credit will only be awarded if you complete required surveys, tests, and lessons.
CME credit will be awarded based upon the number of lessons and corresponding quizzes you successfully complete.

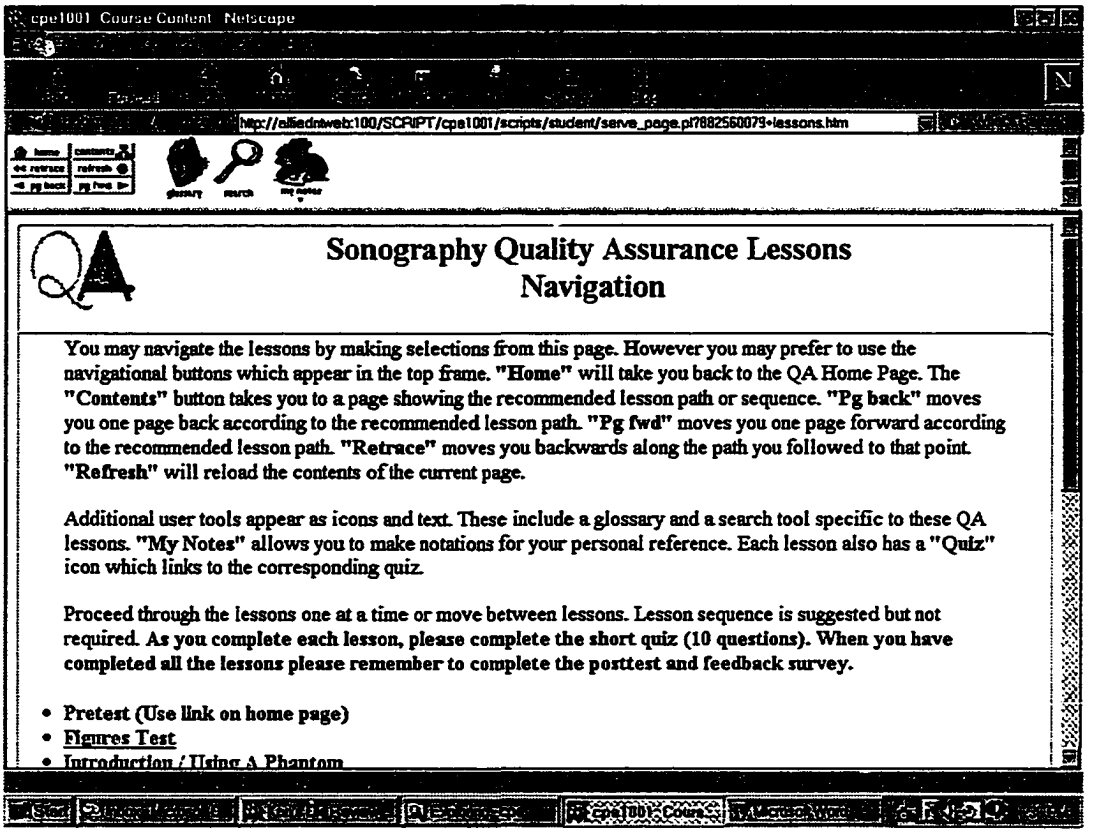
This page has been accessed 00591 times.

Appendix B2

Navigation Instructions

Appendix B2

Navigation Instructions



Appendix B3

Recommended Lesson Path

[Home]

Appendix B4

Sample Lesson

Sonography Quality Assurance Lesson

Lateral Resolution

Lateral Resolution is the closest spacing between two objects that can be resolved perpendicular to (across) the beam axis.

This QA procedure will help you assess lateral resolution for various transducers and focal settings. Lateral resolution is not uniform throughout an image. It varies with beam width, which may be described as an hour-glass or bow-tie shape. Lateral resolution should be best (smallest value) in the focal zone and gradually increases above and below the focal zone.

Clinical Examples

Lateral resolution influences the accuracy of measurements made along the horizontal axis of an image. Therefore it affects the appearance and width measurements of small objects or layers, such as focal lesions, stones, vessel walls, and organ walls or dimensions. This is one reason fetal BPD's are oriented from "top to bottom" on the display and are measured from leading edge to leading edge. This optimizes the resolution of the fetal skull and measurement accuracy. Lateral resolution introduces error into the length measurements of objects made horizontally across the display, rather than vertically (i.e. kidney length and femur length).

In this procedure, the transducer is aligned to horizontally image a set of closely-spaced filaments of known spacings. The distance between the closest filaments which can be resolved is then "quoted" as the lateral resolution. No electronic calipers are necessary for this measurement, as that would introduce additional error and contradicts the basis for using a "standard".

- Gallbladder
- Kidney length
- Femur length
- Beam width

Variables

1. Frequency of transducer, 2. Power / Output, & 3. Gain 4. Beam Focusing 5. Transducer Diameter (aperture) 6. Beam Width	• Hold variables #1 - 5 constant • Variation should be due to #6

Equipment Settings

1. Frequency of transducer
2. Power / Output
3. Gain
4. Focal Setting
  ◦ Variable
  ◦ Fixed
5. Transducer Diameter (if available)
	• Filaments should be point targets.
	• Set controls very carefully at first test.
	• Record settings to use for repeat tests.

Required Image(s)

- Document resolution filament groups at multiple depths.
  ATS #539 @ 7 cm | Zoom
  Nuc Assoc #84-317 @ 19 cm | Zoom
- Demonstrate filaments perpendicular to beam axis as point targets.

Measurements to Record

1. Determine which filaments in resolution group are resolved.
2. Quote the spacing of the closest resolvable filaments lying perpendicular to the beam axis.
3. Filament spacings are provided in phantom manufacturer documentation, and some are provided in the introductory lesson.
4. Using a resolution group remains the preferred method to estimate lateral resolution for QA purposes.
   - **Avoid** measuring beam width directly with calipers, as this adds an additional source of measurement error. However, this method is useful for evaluating general patterns of beam shape (see Accuracy section below).
   - **Do not** measure minimum filament spacing with calipers, as this also adds an additional source of measurement error.

Accuracy

• Lateral resolution = Beam width • Lateral resolution is best at focal	

zone. • Beam width increases as distance from focal zone increases. • Lateral resolution is symmetrical on either side of focal zone. • Example Image	• Look for any changes in settings or system performance since the most recent QA test.

Guidelines

• Perform on ALL new transducers to establish an initial baseline measurement.	• Repeat regularly on frequently used transducers.

Suggestions for Exploring the Demo

- Compare images within the "Resolution Focal Change" Demo.
  - For each frequency transducer, which filament dimensions change when the focal position is changed?
  - For each frequency transducer, which filament dimensions change when the gain & log compression settings are changed?
  - Does the lateral resolution change when the focal position is changed?
- Compare images within the "Resolution Freq & Gain" Demo.
  - For each frequency transducer, which filament dimensions change when the field -of-view is changed?
  - For each frequency transducer, which filament dimensions change when the gain & log compression settings are changed?
  - Does the lateral resolution change when the frequency is changed?
  - Is the lateral resolution uniform at different image depths?
- Compare images within the "Beamwidth" Demo.
  - Which filament dimensions change when the focal position is changed?
  - Is the lateral resolution uniform at different image depths?
  - What is the relationship between the focal position and the narrowest filament width?
- You may need to adjust room lighting and computer monitor brightness to see some of the filaments.

Remember:

Select the **"Pg Fwd"** button in the top frame to proceed to the next QA lesson.
Select **"Contents"** to view an index of the recommended lesson path.

Appendix C

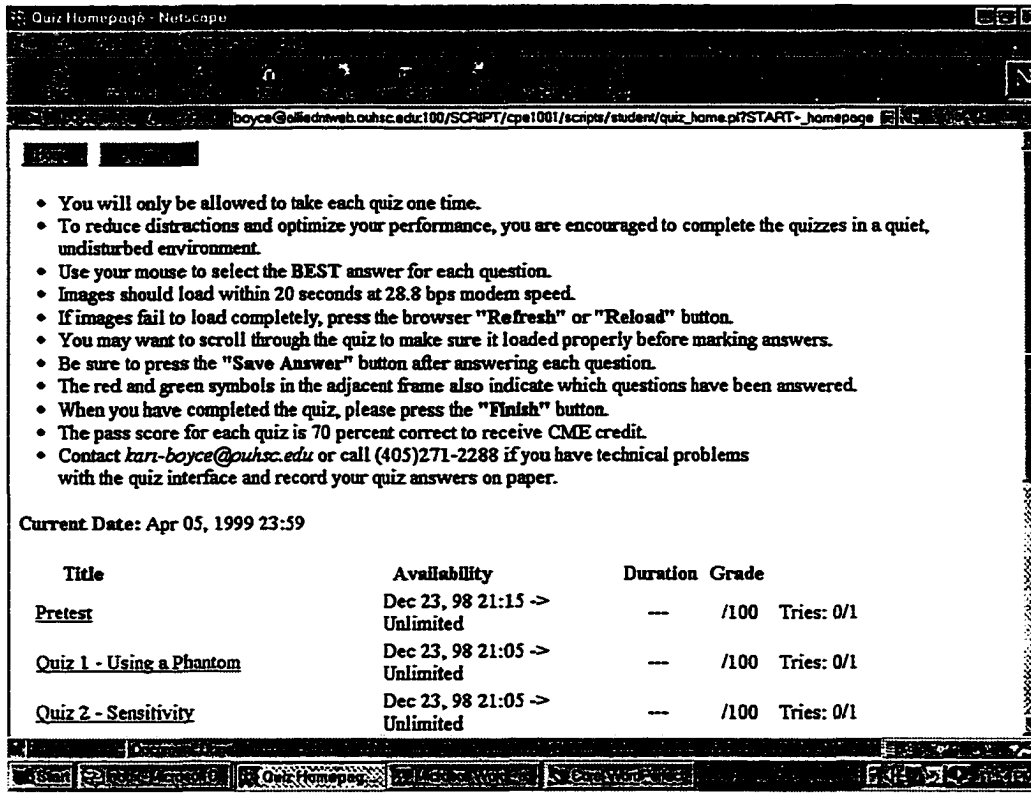
Performance Measures

Appendix C1

Index of Quizzes

Appendix C1

Index of Quizzes

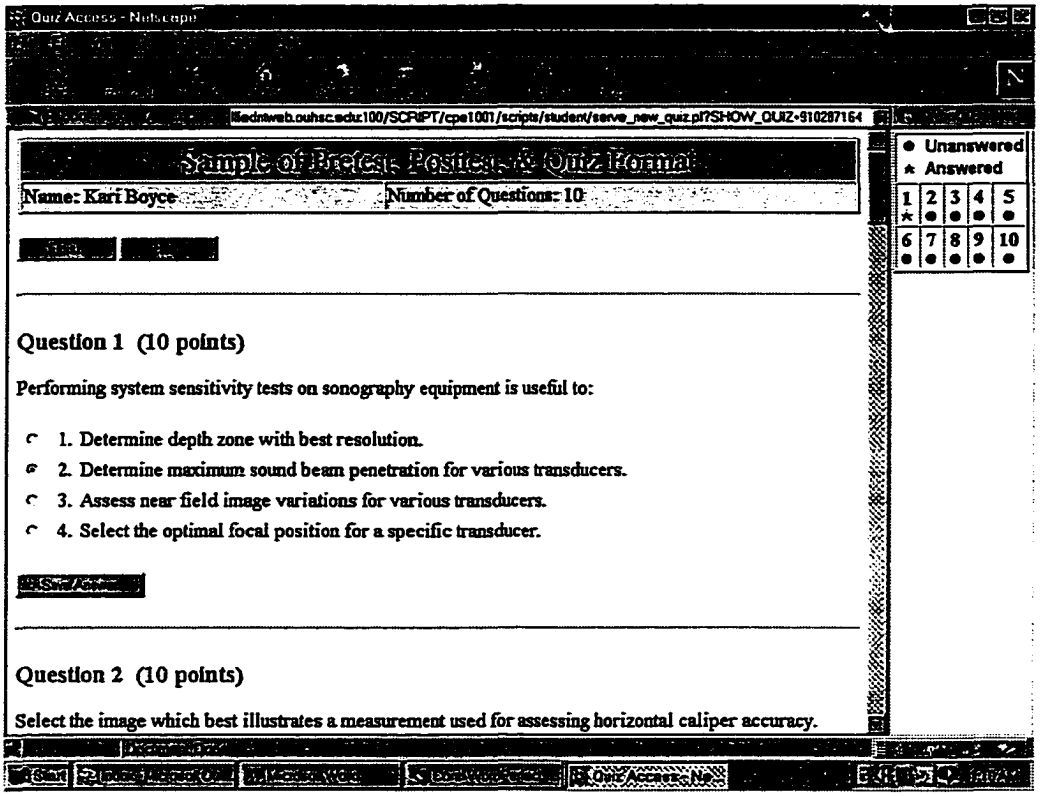


Appendix C2

Sample Quiz Format

Appendix C2

Sample Quiz Format



Appendix D

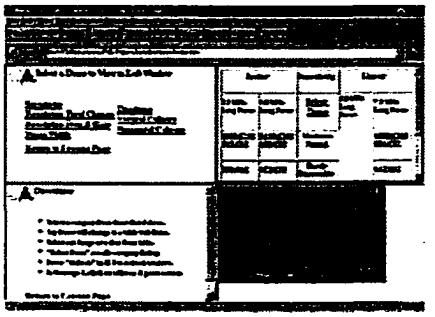
Interactive Image Demonstration

Appendix D1

Directions

Directions for Demo Window

1. **Maximize window to fill computer screen.**
2. **Use one of the top frames to select a category from list.**
3. **Top frame will change to a table with links.**
4. **Select one image at a time from table.**
5. **Repeat steps for other side of browser window.**
6. **Bottom frames allow you to compare two images.**
7. **"Select Demo" recalls category listing.**
8. **Temporarily increase monitor brightness to see faint images.**
9. **Continue to Demo ...**

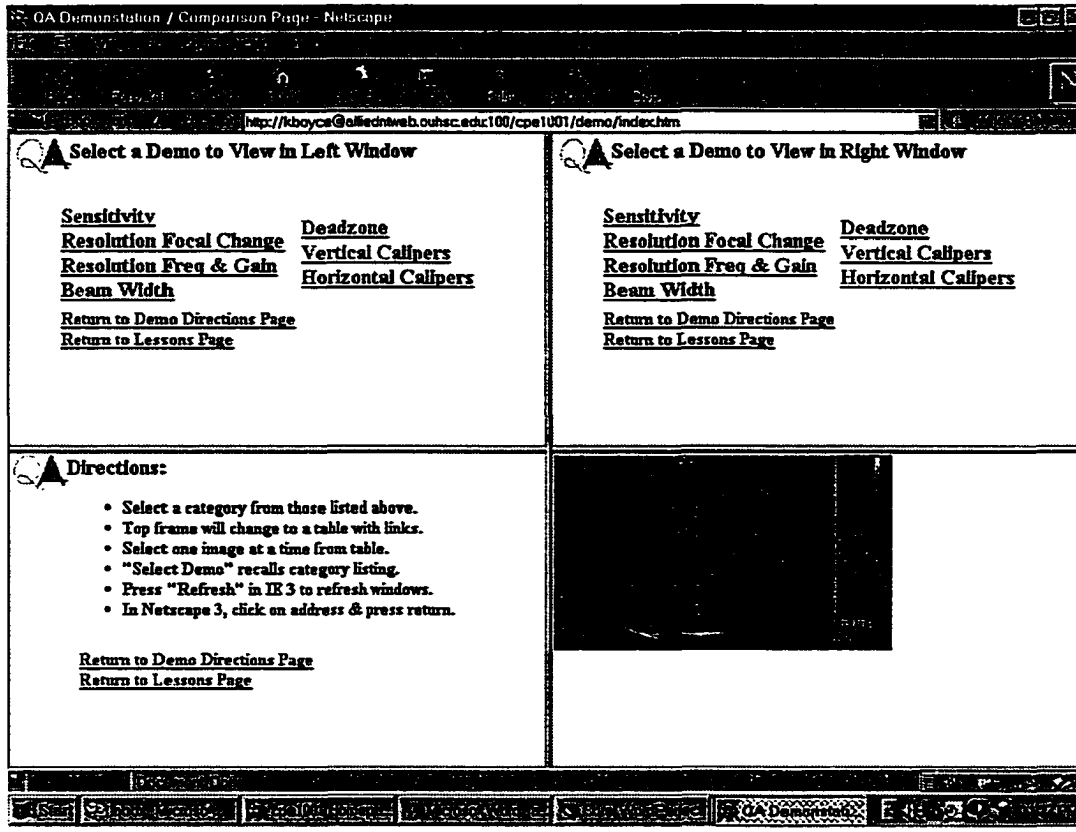


Appendix D2

Opening Screen

Appendix D2

Opening Screen

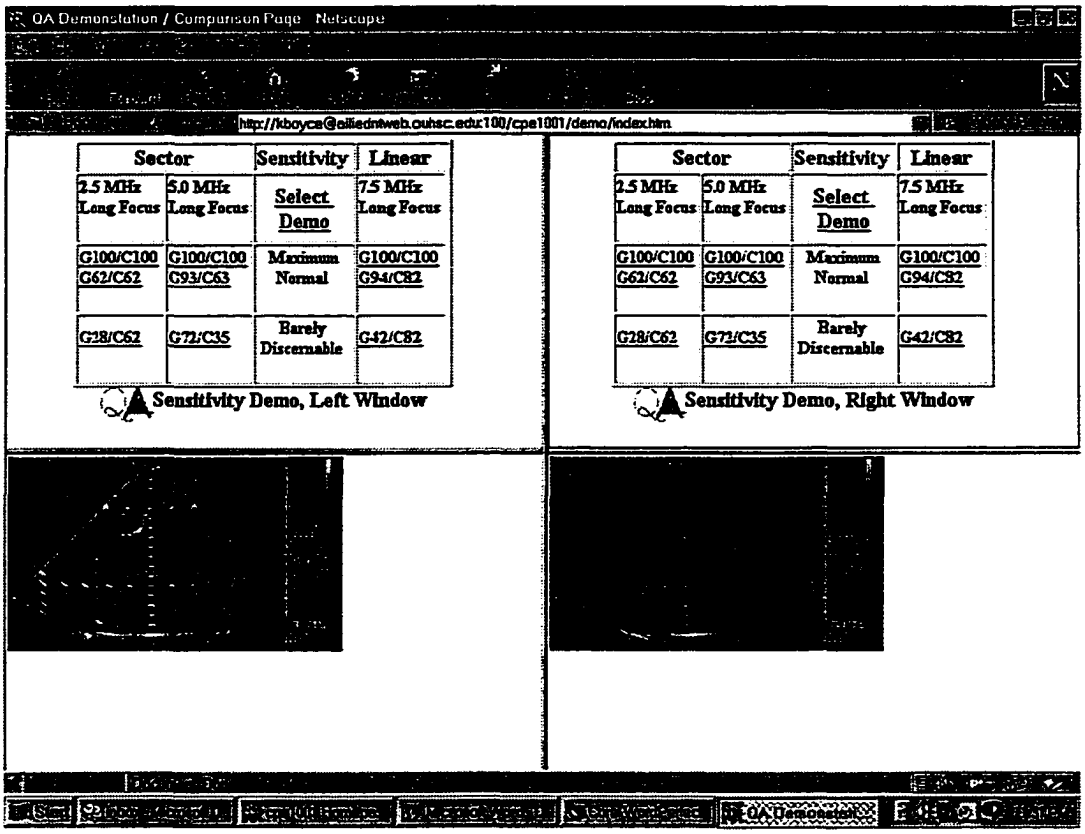


Appendix D3

Sample of Image Demonstration

Appendix D3

Sample of Image Demonstration



Appendix E

Hidden Figures Test

Appendix E1

Methodology and Results for Alternate Form Reliability

Methodology and Results for HFT Alternate Form Reliability Pilot Study

Web-Based Hidden Figures Test

The Hidden Figures Test (HFT) is used to measure the cognitive styles of field dependence and field independence. HFT is a self-administered timed test which uses figures similar to those used on the GEFT and EFT. There are 32 items, divided into two sections of 16 items, with a time allotment of 12 minutes for each the section. Each multiple-choice item requires the individual to select which one of five simple shapes is embedded within a more complex pattern. The test is consider to have high reliability and good construct validity with the GEFT (range from 0.67 - 0.88). This tool is part of the Kit of Factor-Referenced Cognitive Tests available from Educational Testing Service (Ekstrom, French, Harman, & Derman, 1976).

A computerized web-version of the HFT was developed for use in this study. To evaluate its alternative form reliability with the paper and pencil test, both forms were administered to a subset of study participants. A description of the methodology used for determining alternative form reliability follows.

All figures from the paper form of the HFT were digitized and inserted on web pages which replicated the printed directions, sample test items and the two sections of the HFT on a web-based form. Using two HTML frames (windows) the five simple figures labeled A, B, C, D, and E were positioned in the top frame of the browser window, while the 16 complex figures appeared in the scrollable bottom frame. The layout of the complex figures matched that of the printed form. Radio button controls which allowed one choice (A, B, C, D, or E) per test item were located below each complex figure. The participant was required to scroll within the bottom frame to see all of the items in each section of the

HFT. All of the figures in the web-based form were identical in proportion to those in the paper form. Pixel dimensions selected for figures provided a similar image size for common computer screen resolutions of 640 x 480 and 800 x 600. At these screen resolutions the simple figures ranged from 1 to 1.5 inches in size and the complex figures ranged from 1.5 to 2.0 inches, which is similar to the dimensions of the figures on the paper form. Image figures were usable but noticeably smaller at a screen resolution of 1024 x 768.

Independent timing of each computer test administration was accomplished by using a javascript timer which operated within the browser window when the HFT web page was opened. This timer began counting when the participant pressed the "start" button at the top of the lower scrollable frame or when they made their first selection in item 1 or 17. The timer, viewable at the bottom of the lower scrollable frame, was set to trigger other events. The participant's choices were automatically submitted to a database when the timer reached 12 minutes or the submit button was selected, whichever came first. Submission of the first section of the HFT triggered the display of verification of test submission and instructions to proceed to the second section of the test. Timing and submission of the second section of the test followed the same timing process. Submission of the second section of the HFT triggered an acknowledgment of submission of test results and on-screen instructions to return to the instructional module and lessons.

Testing Procedures

The web-based HFT and the pencil and paper HFT were administered to two groups of participants. Group assignment was accomplished using a blocked randomized technique. Group A (n=11) completed the print version of HFT first, immediately

followed by the web-based form. Group B (n=11) completed the web-based HFT first, immediately followed by the print version. For administration of the print version of HFT, the researcher read the established standard instructions. The only delay between administrations was a brief time lapse for the participants to change testing sites. No control group was included in the design of this study. Detailed written instructions which were provided to Group A and B are provided in Appendix E2.

Subjects

A total of 22 subjects completed the alternate HFT reliability procedure. The participants were predominately female (n=18). Sixteen participants were senior sonography students and six were clinical sonographers.

Results

The grand HFT score mean for all subjects was 7.77 with a standard deviation of 4.54. The scores ranged from -0.25 to 16.00, with a median score of 8.00. Table E1 presents the mean HFT scores by form and administration sequence.

The objective for this study was to determine the reliability of the computer version as an alternate form of the paper HFT. Therefore the first analysis was to assess the correlation between form administrations. Pearson product-moment correlations were calculated for the first and second administrations of the HFT forms. An $r = 0.86$ indicates a significant relationship between the two administrations for $p < 0.05$. In addition, the Pearson product-moment correlation was calculated for the computer and paper forms without regard to the administration sequence. An $r = 0.74$ indicates a significant relationship also exists between these two forms of the HFT for $p < 0.05$.

Table E1 - Mean HFT Scores

Form	N	mean	median	SD	SE	Range	Sum	Var	CV
Computer 1	11	6.66	6.75	4.83	1.46	0.50-14.75	73.25	23.34	72.55
Paper 1	11	6.57	7.75	4.59	1.38	-0.25-16.00	72.25	21.04	69.83
Computer 2	11	8.81	9.00	4.02	1.21	1.75-14.00	97.00	16.19	45.63
Paper 2	11	9.05	9.75	4.70	1.42	1.75-16.00	99.50	22.11	51.98
First Form	22	6.61	6.88	4.59	0.98	-0.25-16.00	145.50	21.14	69.51
Second Form	22	8.90	9.75	4.27	0.91	1.75-16.00	196.50	18.25	47.83
All Computer	22	7.74	8.25	4.48	0.95	0.50-14.75	170.25	20.04	57.85
All Paper	22	7.81	8.0	4.71	1.00	-0.25-16.00	171.75	22.15	60.29

The grouping for the FDI variable was determined by taking the total score range (- 0.25 to 16.00) and dividing it into equal thirds. These divisions also correspond with natural breaks in participant scores for Form 1 (see Appendix E3). Following this process, eight subjects were identified as field dependent (FD), ten as field mixed (FM), and four as field independent (FI), based upon Form 1 scores. Table E2 presents the mean HFT scores for these subjects. Table E3 is an alternative presentation of mean scores by form and sequence. Figure E3 (located in Appendix E3) illustrates Form 1 and Form 2 scores for each subject.

Table E2 - Mean HFT Scores by FDI

Form	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	8	1.69	1.88	1.29	0.46	-0.25- 3.50	13.50	1.67	76.67
FM	10	7.73	7.88	1.22	0.38	5.75-10.00	77.25	1.48	15.74
FI	4	13.69	13.88	2.01	1.01	12.00-16.00	54.75	4.06	14.72

Table E3 - Mean HFT Scores by Form and Sequence

Form Sequence (n=22)	Paper HFT	Computer HFT	Row Mean	Row Difference (order effect)
Paper >> Computer	6.57	8.81	7.69	2.24
Computer >> Paper	9.05	6.66	7.855	2.39
Column Mean	7.81	7.735		

Multiple pairwise analyses were performed to assess the following null hypotheses. Complete descriptive statistics for each form grouping are provided in Table E1.

H1 The means scores for Paper 1 and Computer 1 forms of HFT will not differ.

H2 The means scores for Paper 2 and Computer 2 forms of HFT will not differ.

H3 The means scores for Paper 1 and Paper 2 forms of HFT will not differ.

H4 The means scores for Computer 1 and Computer 2 forms of HFT will not differ.

H5 The means scores for All Paper and All Computer forms of HFT will not differ.

H6 The means scores for Form 1 and Form 2 administrations of HFT will not differ.

Hypotheses One and Two

For evaluation of the first two hypotheses n = 22, as each subject completed one or the other of these forms. For the Paper 1 and Computer 1 analysis, the t statistic equaled 0.045 with a p value of 0.9643. This indicated there was not a significant difference in the means for these two forms. Therefore H1 was accepted. This finding supported the alternate form reliability of the computer form of HFT.

For the Paper 2 and Computer 2 analysis, the t statistic was - 0.122 with a p value of 0.9043. This indicates there was not a significant difference in the means for

these two forms. Therefore H2 was accepted. This finding supported the alternate form reliability of the computer form of HFT.

Hypotheses Three and Four

For evaluation of the next two hypotheses n = 22, since each subject completed one or the other of these forms. For the Paper 1 and Paper 2 analysis, the t statistic was - 1.2311 with a p value of 0.2254. This indicated there was not a significant difference in the means for these two forms. Therefore H3 was accepted. This finding supported the alternate form reliability of the computer form of HFT.

For the Computer 1 and Computer 2 analysis, the t statistic equaled - 1.139 with a p value of 0.2682. This indicates there was not a significant difference in the means for these two forms. Therefore H4 was accepted. This finding supported the alternate form reliability of the computer form of HFT.

Hypotheses Five and Six

The number for the analyses of the last two hypotheses was 44, since it used repeated measurement data. A paired t-test was used in these analyses. Table E3 presents values relevant to these hypotheses.

For the All Paper and All Computer analysis, the paired t-test = - 0.0957 with a p value of 0.9247. This indicated there was not a significant difference in the means for these two forms. Therefore H5 was accepted. This finding supported the alternate form reliability of the computer form of HFT.

For Form 1 and Form 2 analysis, the paired t-test = - 4.6184 with a p value of 0.0001. This indicated there was a significant difference in the means for these two forms. Therefore H6 was rejected. This finding did not contradict the alternate form reliability of

the computer form of HFT. The difference in means was likely attributable to an order or practice effect. The mean difference between form administrations was 2.318 points on a 16 point scale. Table E3 also shows differences in mean scores by administration sequence. Appendix E3 illustrates the order effect by subject between Form 1 to Form 2. Only 20 subject lines are visible in this figure because two sets of subjects had identical scores. In addition, by applying a linear model of "Form 2 = 3.64 + (0.8 Form 1)", 74% of the variance can be explained.

Summary

The findings from analyses of the six hypotheses support the use of the computerized web-based version of the Hidden Figures Test as an alternative form for the paper and pencil version. The only hypothesis which was rejected was consistent with the expected order effect from repeated measures over a short time frame. As a result, the computerized web-based version of the HFT was used for establishing FDI classification for the primary study described in this document.

Appendix E2

Group A and B Written Instructions

Group A (Paper Version First – ROB 228)

1. Review and sign consent form (paper)
2. Wait to receive instructions for completing the HFT
3. As you complete each part of the HFT, please wait quietly until entire group is finished.
4. When entire Group A is finished and Group B has finished, both groups will exchange rooms
5. Proceed to the "Computer Room", ROB 218
6. Logon to a computer, if you forgot your password, you can use "labguest" and "welcome"
7. Verify that the monitor resolution is set for 800 x 600 resolution and at least 256 colors (Start... Settings... Control Panel... Display... Settings... , click OK for changes to take effect)
8. You may also need to restart the computer for the changes to take effect
9. Open Netscape Communicator (web-browser) software
10. Go to http://moon.ouhsc.edu/kboyce/cpe/
11. Follow link to "Invitation Page"
12. Scroll to bottom of "Invitation Page"
13. Logon using LoginID & password provided by Ms. Boyce
14. Click on "Figures Test" icon
15. Read instructions (a little bit different than previous version)
16. Proceed to Part 1 when you are ready and submit it when you are completed
17. Verify proper submission of Part 1
18. Proceed to Part 2 when you are ready and submit it when you are completed.
19. Verify proper submission of Part 2, then close that browser window
20. If the rest of the group is still working, please select "Tests & Quizzes" icon
21. Select the "Pretest" link, complete the questions as directed
22. If you still have time after completing the "Pretest", please proceed to "Course Content" and begin reviewing the "Navigation" and "Intro to Using a Phantom" lessons
23. Close all browser windows to exit the module
24. Shut down your computer, by selecting "Exit and logon as a different user"
25. When all of Group A has finished the "Figures Test" you will be dismissed
26. Please leave quietly, as Group B is likely to still be in session

Your account for this educational module will be valid for 30 days. Please return and complete the lessons, quizzes, posttest, and feedback survey. In addition, you will need to fill out the "Registration Survey" which we skipped today to receive CME credits and quiz scores. The Registration Survey and another page with answers to questions about the module are linked at the top of the "Invitation Page". Return to the web address listed above and you will find it by following the links.

Thank you very much for your participation!

Kari E. Boyce, M.Ed., RDMS, RDCS
Principle Investigator

Group B (Computer Version First – ROB 218)

1. Review and sign consent form (paper)
2. Logon to a computer, if you forgot your password, you can use "labguest" and "welcome"
3. Verify that the monitor resolution is set for 800 x 600 resolution and at least 256 colors (Start... Settings... Control Panel... Display... Settings... , click OK for changes to take effect)
4. You may also need to restart the computer for the changes to take effect
5. Open Netscape Communicator (web-browser) software
6. Go to http://moon.ouhsc.edu/kboyce/cpe/
7. Follow link to "Invitation Page"
8. Scroll to bottom of "Invitation Page"
9. Logon using LoginID & password provided by Ms. Boyce
10. Click on "Figures Test" icon
11. Read online instructions
12. Proceed to Part 1 when you are ready and submit it when you are completed
13. Verify proper submission of Part 1
14. Proceed to Part 2 when you are ready and submit it when you are completed
15. Verify proper submission of Part 2, then close that browser window
16. If the rest of the group is still working, please select the "Tests & Quizzes" icon
17. Select the "Pretest" link, complete the questions as directed
18. If you still have time after completing the "Pretest", please proceed to "Course Content" and begin reviewing the "Navigation" and "Intro to Using a Phantom" lessons
19. Close all browser windows to exit the module
20. Shut down your computer, by selecting "Exit and logon as a different user"
21. When all of Group B is finished and Group A is finished , both groups will exchange rooms
22. Proceed to the other room, CHB 228
23. Wait to receive instructions for completing the HFT
24. As you complete each part of the HFT, please wait quietly until entire group is finished
25. When entire Group B is finished, you will be dismissed

Your account for this educational module will be valid for 30 days. Please return and complete the lessons, quizzes, posttest, and feedback survey. In addition, you will need to fill out the "Registration Survey" which we skipped today to receive CME credits and quiz scores. The Registration Survey and another page with answers to questions about the module are linked at the top of the "Invitation Page". Return to the web address listed above and you will find it by following the links.

Thank you very much for your participation!

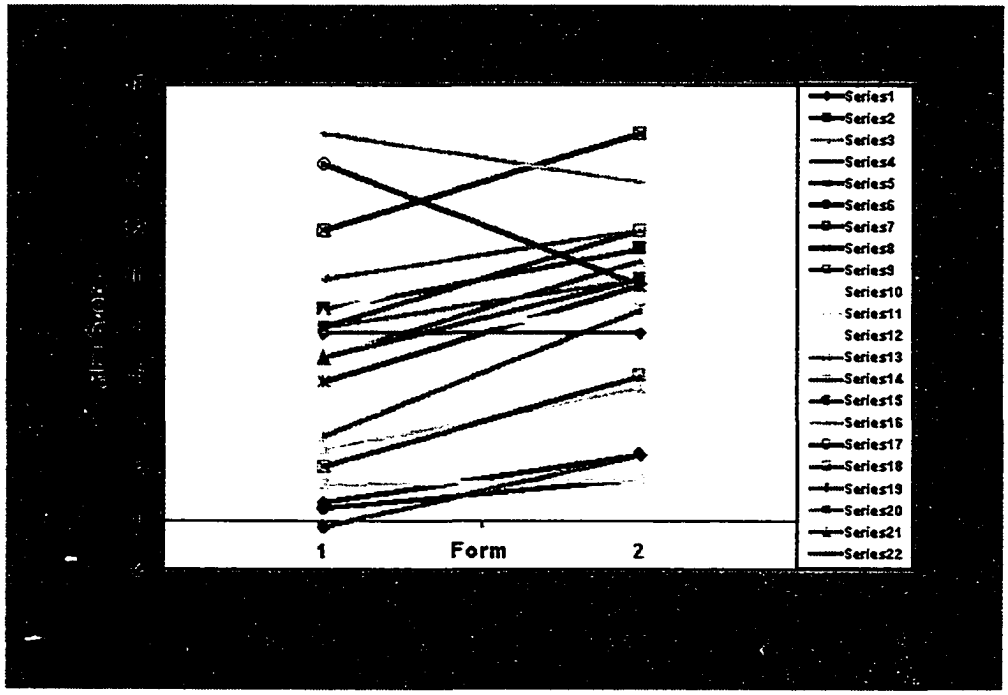
Kari E. Boyce, M.Ed., RDMS, RDCS
Principle Investigator

Appendix E3

Form 1 and Form 2 HFT Scores

Figure E3

Form 1 and Form 2 HFT Scores



Appendix F

Evaluation Tools

Appendix F1

Feedback Survey and Results Summary

Sonography Quality Assurance Lessons

Feedback Survey Results

Enter your LoginID:

1. Did this educational module meet your expectations?

Results for Item 1: (n = 38)

33, 86.8% = Yes
5, 13.2% = No

2. Did this educational module meet your continuing education needs?

Results for Item 2: (n = 38)

31, 81.6% = Yes
7, 18.4% = No

3. Did you use any of the following WebCT navigational tools?

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 3: (n = 38)

☐34, 89.5% = Yes - Home
☐28, 73.7% = Yes - Content
☐3, 7.9% = Yes - Retrace
☐7, 18.4% = Yes - Refresh
☐32, 84.2% = Yes - Page Back
☐29, 76.3% = Yes - Page Forward

4. If you answered Yes in Question #3, which one of the following methods did you USUALLY use to select the next lesson?

Results for Item 4: (n = 38)

12, 32.4% = Page Forward
19, 51.4% = Content (lesson outline)
3, 8.1% = Other (Please specify in following textbox)

5. Did you find the WebCT navigational tools useful?

Results for Item 5: (n = 38)

37, 97.4% = Yes
0 = No

6. Did you ever have a sense of "becoming lost" while using this module?

Results for Item 6: (n = 38)

17, 44.7% = Yes
21, 55.3% = No

7. If you answered Yes to Question #6, how frequently did the sense of "becoming lost" occur?

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 7: (n = 17)

☐10, 26.3% = While getting oriented to website
☐9, 23.7% = While getting oriented to first module lesson
☐1, 5.9% = During every lesson
☐4, 10.5% = When completing the quizzes, pretest, or posttest
☐4, 10.5% = When completing the Figures Test
☐5, 13.2% = When using the interactive demos
☐7, 18.4% = Gradually became less frequent
☐1, 2.6% = Seldom (No Lost Group)
☐0 = Other (Please specify in following textbox)
☐3, 17.6% = Yes Lost Group - Blank
☐20, 52.6% = No Lost Group - Blank

Results for Item 8: (n = 17)

8. If you answered Yes to Question #6, what did you do to overcome the sense of "becoming lost"?

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

☐2, 5.3% = Pressed "back" button on browser tool bar
☐2, 5.3% = Pressed "forward" button on browser tool bar
☐7, 18.4% = Pressed "home" button on browser tool bar
☐0 = Closed browser window
☐1, 2.6% = Reopened browser window
☐6, 15.8% = Pressed "home" button on WebCT tool bar
☐3, 7.9% = Pressed "content" button on WebCT tool bar
☐0 = Pressed "retrace" button on WebCT tool bar
☐0 = Pressed "refresh" button on WebCT tool bar
☐3, 7.9% = Pressed "page back" button on WebCT tool bar
☐3, 7.9% = Pressed "page forward" button on WebCT tool bar
☐1, 2.6% = Selected "glossary" icon on WebCT tool bar
☐1, 2.6% = Selected "search" icon on WebCt tool bar
☐1, 2.6% = Followed a link within page content
☐3, 7.9% = Quit lesson
☐3, 7.9% = Started a different lesson
☐2, 5.3% = Other (Please specify in following textbox)
☐1, 2.6% = Yes Lost Group - Blank
☐21, 55.3% = No Lost Group - Blank

9. Do you think a sense of "becoming lost" influenced your USE of any lessons?

Results for Item 9: (n = 38)

6, 15.8% = Yes
27, 71.1% = No

10. Do you think a sense of "becoming lost" influenced your COMPLETION of any lessons?

Results for Item 10: (n = 38)

4, 10.5% = Yes
30, 79.0% = No

11. **Do you think a sense of "becoming lost" influenced your PERFORMANCE on any quizzes?**

Results for Item 11: (n = 38)

10, 26.3% = Yes
24, 63.2% = No

12. **What do you consider the BEST FEATURES of this educational module?**

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 12: (n = 38)

☐5, 13.2% = Pre-registration information
☐4, 10.5% = Registration survey
☐2, 5.3% = Consent form
☐17, 44.7% = Timeliness of receiving LoginID & password
☐11, 28.9% = Login process
☐20, 52.6% = Test & Quiz format
☐9, 23.7% = Pretest content
☐11, 28.9% = Posttest content
☐5, 13.3% = Feedback survey
☐6, 15.8% = Other opportunities for feedback (author email / phone number)
☐3, 7.9% = Figures Test format
☐4, 10.5% = Figures Test content
☐20, 52.6% = Lessons (in general)
☐14, 36.8% = Quizzes (in general)
☐9, 23.7% = Download time for module pages
☐25, 65.8% = 24 hour access to module
☐26, 68.4% = Free CME credit for successful completion
☐12, 31.6% = Content (lesson outline)
☐13, 34.2% = WebCT navigational tool bar
☐4, 10.5% = WebCT Glossary tool
☐3, 7.9% = WebCT Index tool
☐3, 7.9% = WebCT Search tool
☐13, 34.2% = Printable QA procedures
☐11, 28.9% = Printable QA forms
☐1, 2.6% = Blank

12. **What do you consider the BEST FEATURES of this educational module?**

Lesson Name	Content	Demos	Quizzes	Image Quality
Using a Phantom	16, 42.1%	7, 18.4%	8, 21.0%	9, 23.7%
Sensitivity	18, 47.4%	8, 21.0%	9, 23.7%	9, 23.7%
Axial Resolution	17, 44.7%	6, 15.8%	9, 23.7%	10, 26.3%
Lateral Resolution	17, 44.7%	6, 15.8%	10, 26.3%	10, 26.3%
Deadzone	20, 52.6%	8, 21.0%	7, 18.4%	11, 28.9%
Vertical Caliper	20, 52.6%	7, 18.4%	9, 23.7%	8, 21.0%
Horizontal Caliper	18, 47.3%	7, 18.4%	6, 15.8%	8, 21.0%
Blank	15, 39.5%			

13. **What do you consider the WEAKEST FEATURES of this educational module?**

Lesson Name	Content	Demos	Quizzes	Image Quality
Using a Phantom	3, 7.9%	6, 15.8%	0 %	2, 5.3%
Sensitivity	3, 7.9%	1, 2.6%	1, 2.6%	3, 7.9%
Axial Resolution	2, 5.3%	3, 7.9%	2, 5.3%	3, 7.9%
Lateral Resolution	2, 5.3%	3, 7.9%	2, 5.3%	3, 7.9%
Deadzone	2, 5.3%	2, 5.3%	1, 2.6%	2, 5.3%
Vertical Caliper	3, 7.9%	1, 2.6%	2, 5.3%	2, 5.3%
Horizontal Caliper	3, 7.9%	1, 2.6%	2, 5.3%	2, 5.3%
Blank	25, 65.8%			

13. **What do you consider the WEAKEST FEATURES of this educational module?**

(multiple selections allowed)

Mark all that apply by selecting the corresponding checkbox with the mouse pointer, pressing once with the mouse button. Unselect any checkbox by repeating the same action.

Results for Item 13: (n = 38)

☐2, 5.3% = Pre-registration information
☐1, 2.6% = Registration survey
☐1, 2.6% = Consent form
☐1, 2.6% = Timeliness of receiving LoginID & password
☐1, 2.6% = Login process
☐2, 5.3% = Test & Quiz format
☐3, 7.9% = Pretest content
☐1, 2.6% = Posttest content
☐0 = Feedback survey
☐1, 2.6% = Other opportunities for feedback (author email / phone number)
☐12, 31.6% = Figures Test format
☐14, 36.8% = Figures Test content
☐0 = Lessons (in general)
☐2, 5.3% = Quizzes (in general)
☐4, 10.5% = Download time for module pages
☐0 = 24 hour access to module
☐0 = Free CME credit for successful completion
☐0 = Content (lesson outline)
☐0 = WebCT navigational tool bar
☐1, 2.6% = WebCT Glossary tool
☐2, 5.3% = WebCT Index tool
☐3, 7.9% = WebCT Search tool
☐1, 2.6% = Printable QA procedures
☐0 = Printable QA forms
☐26, 68.4% = Blank

14. Please rate the quality of the material covered in this course.

Results for Item 14: (n = 38)

15, 39.5% = 1 = excellent
13, 34.2% = 2
9, 23.7% = 3
0 = 4
0 = 5 = poor

15. Please rate the presentation of the material covered in this course.

Results for Item 15: (n = 38)

20, 52.6% = 1 = excellent
9, 23.7% = 2
8, 21.1% = 3
0 = 4
0 = 5 = poor

16. Please tell me which web browser(s) you used for the module. Please include the version if known. You are welcome to provide these and additional comments in the adjacent textbox.

Results for Item 16: (n = 38)

5, 13.2% = Blank
1, 2.6% = Both IE and Netscape
11, 28.9% = Internet Explorer
19, 50.0% = Netscape
2, 5.3% = Other

Last updated by Kari Boyce on January 25, 1999

Appendix G

Results

Appendix G1

Descriptive Statistics Table

Table G1

Descriptive Statistics Table

PRETEST	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	13	52.31	60	17.39	4.82	20-80	680	302.56	33.25
FM	11	61.82	60	16.62	5.01	20-80	680	276.36	26.89
FI	9	65.56	70	21.28	7.09	30-90	590	452.78	32.46
All above	33	59.09	60	18.60	3.24	20-90	1950	346.02	31.48
All participants	64	52.3	50	19.16	2.39	20-90	3350	367.43	36.62

QUIZ 1	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	13	70.00	80	18.71	5.19	40-90	910	350.00	26.73
FM	11	70.91	80	23.00	6.94	10-90	780	529.09	32.44
FI	9	80.22	80	15.63	5.21	50-100	740	244.44	19.12
All above	33	73.64	80	19.66	3.42	10-100	2430	386.36	26.69
All participants	50	71.8	80	20.27	2.87	10-100	3590	410.98	28.23

QUIZ 2	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	13	66.15	70	24.34	6.75	10-100	860	592.31	36.79
FM	11	69.09	70	20.71	6.25	40-100	760	429.09	29.98
FI	9	83.33	90	14.14	4.71	60-100	750	200.00	16.97
All above	33	71.82	70	21.43	3.73	10-100	2370	459.09	29.83
All participants	43	72.33	70	20.57	3.14	10-100	3110	423.03	28.44

QUIZ 3	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	13	50.77	50	16.56	4.59	10-70	660	274.36	32.63
FM	11	65.45	70	25.83	7.79	10-100	720	667.27	39.46
FI	9	77.78	80	18.56	6.19	40-100	700	344.44	23.86
All above	33	63.03	60	22.84	3.97	10-100	2080	521.78	36.24
All participants	40	64.25	70	21.47	3.39	10-100	2570	460.96	33.42

QUIZ 4	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	13	60.77	60	12.56	3.48	40-80	790	157.69	20.66
FM	11	64.55	70	22.07	6.66	20-90	710	487.27	34.20
FI	9	84.44	80	12.36	4.12	60-100	760	152.78	14.64
All above	33	68.48	70	18.73	3.26	20-100	2260	350.76	27.34
All participants	39	68.97	70	19.17	3.07	20-100	2690	367.34	27.79

QUIZ 5	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	13	75.38	80	20.66	5.73	20-100	980	426.92	27.41
FM	11	78.18	90	21.83	6.58	30-100	860	476.36	27.92
FI	9	94.44	90	5.27	1.76	90-100	850	27.78	5.58
All above	33	81.51	90	19.55	3.40	20-100	2690	382.01	23.98
All participants	39	80.77	90	19.24	3.08	20-100	3150	370.45	23.83

QUIZ 6	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	13	81.54	80	16.25	4.51	40-100	1060	264.10	19.93
FM	11	80.91	80	17.00	5.13	40-100	890	289.09	21.01
FI	9	90.00	90	8.66	2.89	70-100	810	75.00	9.62
All above	33	83.64	90	14.96	2.60	40-100	2760	223.86	17.89
All participants	39	85.13	90	14.49	2.32	40-100	3320	209.85	17.02

QUIZ 7	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	13	56.15	60	22.19	6.15	20-100	730	492.31	39.51
FM	11	76.36	90	27.30	8.23	30-100	840	745.45	35.75
FI	9	90.00	90	10.00	3.33	70-100	810	100.00	11.11
All above	33	72.12	80	25.34	4.41	20-100	2380	642.23	35.14
All participants	39	72.82	80	23.84	3.82	20-100	2840	568.15	32.73

POSTTEST	N	mean	median	SD	SE	Range	Sum	Var	CV
FD	13	70.77	70	14.41	3.99	30-85	920	207.69	20.36
FM	11	70.90	70	12.81	3.86	50-95	780	164.09	18.07
FI	9	87.22	90	9.39	3.13	70-100	785	88.19	10.77
All above	33	75.30	75	14.36	2.50	30-100	2485	206.15	19.07
All participants	37	74.73	75	14.72	2.42	30-100	2765	216.59	19.69

Appendix H

Letters of Permission

Appendix H1

Institutional Review Board

The University of Oklahoma

OFFICE OF RESEARCH ADMINISTRATION

December 9, 1998

Ms. Kari E. Boyce
3512 NW 44th Street
Oklahoma City OK 73112

Dear Ms. Boyce:

Your research proposal, "Delivering Continuing Professional Educaiton at a Distance: The Correlation of Field Dependence/Independence and Learner Success Using the World Wide Web," has been reviewed by Dr. E. Laurette Taylor, Chair of the Institutional Review Board, and found to be exempt from the requirements for full board review and approval under the regulations of the University of Oklahoma-Norman Campus Policies and Procedures for the Protection of Human Subjects in Research Activities.

Should you wish to deviate from the described protocol, you must notify me and obtain prior approval from the Board for the changes. If the research is to extend beyond 12 months, you must contact this office, in writing, noting any changes or revisions in the protocol and/or informed consent form, and request an extension of this ruling.

If you have any questions, please contact me.

Sincerely yours,

Debbie Jennings
Interim Administrative Officer
Institutional Review Board

DJ:pw
FY99-115

cc: Dr. E. Laurette Taylor, Chair, IRB
Dr. Robert Fox, Educational Leadership & Policy Studies

1000 Asp Avenue, Suite 314, Norman, Oklahoma 73019-0430 PHONE: (405) 325-4757 FAX: (405) 325-6029

Appendix H2

Educational Testing Service

LICENSING AGREEMENT

THIS AGREEMENT, entered into as of December 16, 1998, between Educational Testing Service (hereinafter called "ETS"), a nonstock, nonprofit corporation organized and existing under the Education Law of the State of New York, with offices at Princeton, New Jersey 08541, and

Kari Boyce
3512 NW 44th Street
Oklahoma City, OK 73112

(hereinafter called "Licensee"),

WITNESSETH:

WHEREAS, ETS is the publisher and copyright owner of certain test materials; and

WHEREAS, Licensee wishes to produce editions of

Hidden Figures Test (CF-1 - Rev.)

NOW, THEREFORE, ETS agrees that Licensee may reproduce and distribute 500 copies of each of the above editions for use in a research study, subject to the following terms and conditions:

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2. Licensee agrees to pay ETS a licensing fee of $50.00. Payment shall be sent to Educational Testing Service to the attention of:

   Lorraine Carmosino
   Administrative Assistant
   Contracts and Proprietary Rights 38-D

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8. It is agreed that any changes in the terms and conditions of this Agreement must be in writing and approved by an authorized representative of ETS.

9. This Agreement shall be considered null and void if it is not signed within 30 days.

LICENSEE

Kari E Boyce

Name: Kari E. Boyce

*Title: Interim Associate Dean
College of Allied Health

Date: January 4, 1999

*as a graduate Student
in the College of Education
University of Oklahoma

EDUCATIONAL TESTING SERVICE

Michelle Greene

Michelle Greene

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Date: 12/16/98

1/89 Form #42 Authorization #096

Appendix H3

Society of Diagnostic Medical Sonographers

Society of Diagnostic Medical Sonographers
12770 Coit Road, Suite 708
Dallas, TX 75251-1319
USA

972-239-7367
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http://www.sdms.org

Memorandum

To: Kari Boyce

From: Susan Magee, Director
Continuing Education Department

Date: December 1, 1998

Re: SDMS CME credit approval

Hi Kari,

Enclosed are the SDMS CME certificate and the approval/evaluation form for your Web-based CME lessons. I have left the date and the number of CME credits blank on the CME certificate. Please make sure to complete the following on the SDMS CME certificates prior to mailing to registrants:

1) the registrant's name date

2) total number of CME credits awarded

3) date

4) your signature

Per the SDMS CME guidelines, on a monthly basis you are to submit a list of the registrants that includes their name, address and e-mail address (if available) and a $2.00 per user fee.

Your work on this project is commendable and I plan to spend more time exploring the website. Please forward the quizzes when they are completed.

Good luck...I look forward to the summary research report. Please call if you have any questions or need additional assistance.

Enclosure

SOCIETY OF DIAGNOSTIC MEDICAL SONOGRAPHERS
CONTINUING MEDICAL EDUCATION APPROVAL FORM

Your request for SDMS Continuing Medical Education Credits has been approved for 3.5 hour(s).

Group/Company Name: College of Allied Health; University of Oklahoma HSC
Program Coordinator: Kari E. Boyce, MEd, RDMS, RDCS
Date of Program: 12/15/98-12/15/99
Type of Program:
Short Term
Local Seminar/Workshop
Commercially Sponsored
Sonographic Portion
Audio/Video Tape
Study Group, Inservice
Permanent Site
Traveling
X-Web-based CME

Date Mailed: 12/1/98
NOTE: It is the responsibility of the Program Director to:

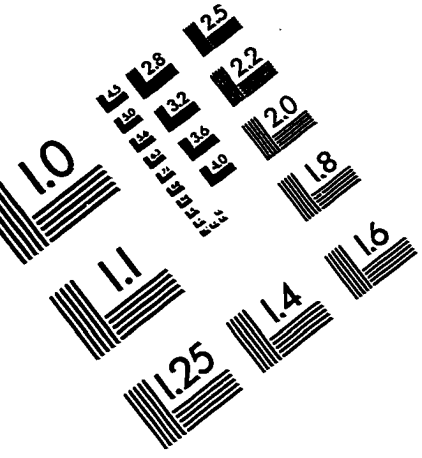
1. Send the evaluation summary (tabulation of the evaluation data)and list of attendees to: SDMS Executive Office, Attn: CME, 12770 Coit Road, Suite 708, Dallas, Texas, 75251. You may copy the form below for program evaluation. Please do not submit each attendee's evaluation form.
2. Provide attendees with the official SDMS CME Certificate. The attendee's name must be filled in prior to issuing it.
3. Refer to SDMS CME File #98-12-02 on all correspondence.

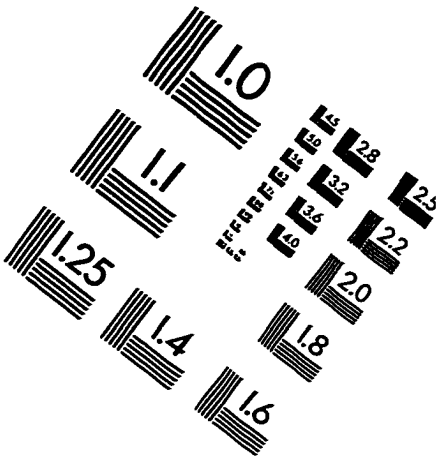
SDMS PROGRAM EVALUATION

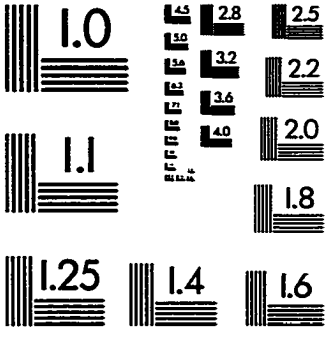
SDMS CME File # 98-12-02
Group/Company: College of Allied Health; University of Oklahoma HSC
Program Title: Sonography Quality Assurance
Date of Meeting: 12/15/98-12/15/99

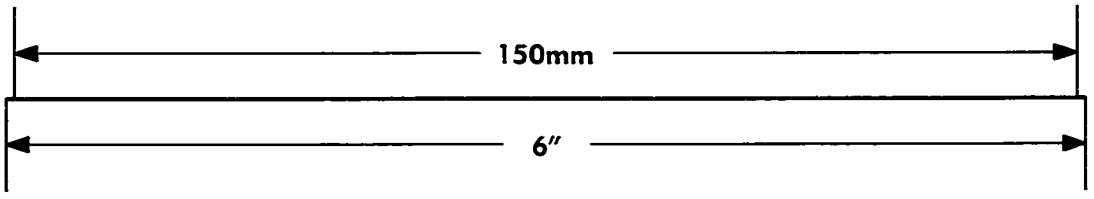
	Excellent	Good	Fair	Poor
1. Overall educational value	1	2	3	4
2. Pertinent new knowledge	1	2	3	4
3. Skills/techniques applicable on the job	1	2	3	4
4. Opportunity for discussion	1	2	3	4
5. Program content				
a. Coverage of basic mechanisms	1	2	3	4
b. Coverage of recent advances	1	2	3	4
6. Quality of speaker(s)	1	2	3	4

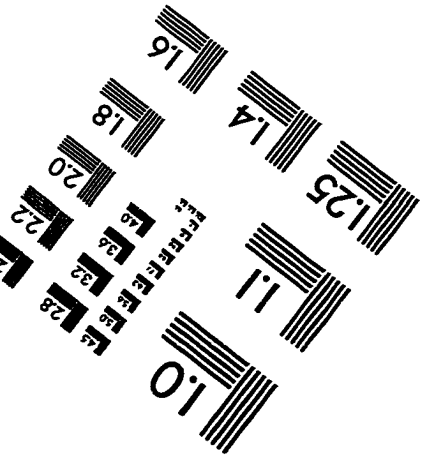
IMAGE EVALUATION
TEST TARGET (QA–3)

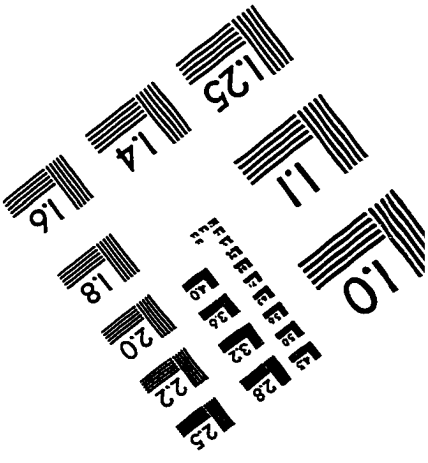












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