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Distance instruction in medical terminology for occupational therapy students in Yokkaichi, Mie, Japan

Diana Steed Medal

DISTANCE INSTRUCTION IN MEDICAL TERMINOLOGY FOR OCCUPATIONAL THERAPY STUDENTS IN YOKKAICHI, MIE, JAPAN

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Education

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ABSTRACT

Distance education and online learning opportunities are growing in number and breadth in recent years. Loma Linda University in California is actively participating in distance education endeavors, one of which is the initiation of a web-based B. S. degree in Occupational Therapy with Humanatec Rehabilitation College in Yokkaichi, Mie, Japan in 2001. One of the introductory courses of this program is Medical Terminology, and the planning for this course is the subject of this paper.

A special web-based learning project for Medical Terminology was created for usage in addition to traditional textbook lessons and lectures via interactive television. The project utilized multiple features of audio and image files to supplement text definitions of Greek and Latin roots in medical terminology. Practice exercises with feedback for medical terminology were also created, and the entire project was developed incorporating the learning theory of constructivism with systematic design. The media for this project was PowerPoint (2000) because of its easy availability to the students in Japan in their campus computer lab. Navigation was structured to incorporate linear and nonlinear approaches to the learning exercises, and the project was

easily uploaded to Blackboard (Blackboard, 2001) courseware under Loma Linda University's license.

Evaluation of the project took place from students enrolled in Loma Linda University who had previously completed a medical terminology course. They reported a generally positive response to the web-based learning project, with comments supportive of multimedia presentation of medical terminology. A detailed description of the design of this learning project and its grounding in learning theory is undertaken here.

Anyone who is interested in viewing this web-based project in Medical Terminology is invited to do so by logging on to http://lluonline.llu.edu for academic year 2001/02. For user identification and password codes, contact the author of this project, Diana Medal, RHIA, at Loma Linda University, School of Allied Health Professions, 1905 Nichol Hall, Loma Linda, CA 92350, phone 909-824-0800 x43759, email Diana-Medal@sahp.llu.edu.

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CHAPTER ONE

BACKGROUND

Introduction

Medical Terminology has been taught as a web-based course in the School of Allied Health Professions at Loma Linda University, California for three quarters in academic years 1999-2001. Review of course evaluations indicated that student comments about their online experience for the most part were split between positive and negative opinion. Those who raved about web-based learning enjoyed the flexibility that online learning provided them. These students lived within an approximate 20-mile radius from Loma Linda University, in the cities and neighboring communities of San Bernardino and Riverside. These students reported appreciation of study from home in the setting of intense curricular demands of health science learning in respiratory therapy, occupational therapy, and physical therapy. Other students lived much greater distances from the university. A one way commute time of 1 ½ hours was not unusual for these students who lived in locations such as Palm Springs, Victorville, Fullerton, and Pomona, ranging 30 to 60 miles from the university. The students from farther distances

also positively embraced the ability to study from home and to free up classroom time while they were on campus at Loma Linda.

But some students reported a negative experience with on-line learning. The overwhelming theme of the negative commentary on their course evaluations was displeasure that the instructor was not in the classroom with them to keep them on task. The evaluators of the web-based learning experience at Loma Linda University found this to be a rather surprising and unexpected finding, one that had not been expected given that the students were at the junior level in college, and all were recipients of a 3.3 grade point average which was a requirement for admission to their health professional training programs. One quote from one student was an extraordinary eye opener, "The teacher needs to be in the classroom to force the students to learn."

As instructor of the web-based Medical Terminology course, I reviewed the course evaluations of these three Internet learning experiences with my department chair, the Technology Committee, and the dean of the School of Allied Health Professions. We concluded that on-line learning should continue to be implemented when appropriate in curriculum. The reasons for this were due

to benefits of learning which many students enjoyed, the wide variety of excellent learning resources available on the Internet, and the university's mission to international health education service, which is uniquely served by distance learning technology.

This history of on-line Medical Terminology instruction served as a backdrop to describe an even more challenging instructional project which faced the university and faculty in May 2001 when the same web-based course was taught, among other courses, to occupational therapy students in Yokkaichi, Mie, Japan. Yokkaichi is an industrial city in Japan, which boasts a private university, Humanatec Rehabilitation College. This school enjoys very active enrollment in health science training programs. One of the busiest health programs at Humanatec Rehabilitation College is in Occupational Therapy, and the many graduates of this program serve the health needs of the aging population in Japan. The president of this college felt a need to strengthen the Occupational Therapy training program, and visited Schools of Allied Health in the United States, hoping to establish a partnership with a U.S. School to train and grant degrees to his students in Japan. After visiting many health science colleges, he selected Loma Linda University, and a contract was drawn

to provide distance education to his students in Japan utilizing two-way audio-visual equipment, web-based learning, visits from faculty to Japan, and visits from Japanese students to Loma Linda, California for directed clinical practice.

Medical Terminology is one of the required courses of these Japanese students. To meet the needs of medical terminology instruction to students at such a great distance from the instructor's home university, many adaptations to the previous course were implemented. All technology supporting distance learning was integrated into the course, and efforts were made to minimize the distractions that appeared to exist in an on-line learning environment. In addition, effort was directed to creating instructional materials which work well with technologically mediated instruction, and which can enhance the learning experience of students who are a great deal of distance away from the instructor.

Learner Characteristics

The students from Yokkaichi University enrolled for on-line Medical Terminology at Loma Linda University in May, 2001 were third year college students who lived in the dormitory at Yokkaichi, Japan. They are of traditional

college age in their late teens and early twenties. They received 1000 hours of English instruction at Humanatec Rehabilitation College, and must pass the Test of English as a Foreign Language (TOEFL) computerized exam with a score of 270, equivalent to the standard TOEFL of 500 in order to be accepted into the Loma Linda training program. Their first course in the program was Introduction to Health Systems. Their Loma Linda courses were taken simultaneously with their Humanatec occupational therapy courses. Next, they enrolled in Medical Terminology, which took place May 1, through June 30, 2001. They received one week face to face instruction by me on the Yokkaichi campus May 1 through 6. Thereafter, I met twice a week for a one-hour lesson using two-way audio-visual equipment. Student collaborative work was planned for the course by including reading report assignments on medical subjects to be posted to an online bulletin board for threaded discussions among the students. They also learned from the web-based Medical Terminology course and their textbook. On a daily basis they were in the classroom at Humanatec University. A Yokkaichi faculty member was with them at all times during their daily sessions. Their classrooms are equipped with state of the art IBM compatible PCs, and a total of 30 computers are installed in the computer lab

enabling each student the use of a PC each day in class. Each computer will be loaded with Microsoft Office and Windows explorer. Enrollment was 20.

Objectives

To prepare for this distance learning experience, identification of three chief design objectives occurred:

- One, develop lesson plans fully utilizing all available technology to deliver instruction in Medical Terminology to students who are physically located thousands of miles away from the instructor.
- Two, adapt the existing on-line course in an attempt to build on strengths, minimize weaknesses, and provide a quality learning experience to students located in another country.
- Three, create instructional materials to support this distance-learning endeavor.

The vehicle of this instructional project was the Internet for flexible access. Multiple media was used in this setting due its ability be used by students with various learning styles. The learning activities included presentation of medical terms, application activities,

assessment, and feedback processes. The feedback is a particular focus of attention in this project given that the instructor was not be able to offer immediate commentary on student performance since she was separated from the students by a distance of several thousand miles. Therefore, the project contained practice drills for students to participate in self-assessment. These practice exercises had multiple-choice answers with immediate responses to inform the student if a new concept had not been learned correctly. The student was guided by links to restudy those elements incorrectly recalled.

Media Selection Rational

The existing web-based course from Loma Linda University in Medical Terminology was used due its convenient access from the World Wide Web. The existing course already resided in Blackboard (Blackboard, 2001) under the Loma Linda University license. I have used Blackboard previously and have enjoyed working with this courseware. I have found that students have easily learned Blackboard, even if they have never taken online courses previously. After one instructional lab session, the majority of students used Blackboard independently with very few phone calls or emails to me later asking for

further help. Adaptations were made to accommodate to students who are citizens of Japan and who studied from there. These adaptations occurred after evaluation took place by an individual familiar with Japanese culture. The medical terminology textbook that has previously been used continued to be used in this learning setting, due to its attractive and straightforward presentation, integration of workbook exercises to assist in the learning process, logical organization by body system, and integration of case studies to provide a realistic problem-based application of the curriculum content. Two-way audiovisual equipment was utilized on a weekly basis and students participated in some lecture activity, and were able to directly communicate with the instructor, albeit through technologically mediated communication. The instructional material development was prepared on PowerPoint (2000), which will be available on all computers in the classroom at Humanatec Rehabilitation College in Japan and also easily uploads to Blackboard's (Blackboard, 2001) online courseware.

To prepare for the development of this instructional plan and effective learning materials, review of the literature on the topics of constructivism, instructional design, and multiple media in learning will be summarized

here. Additionally, substantial literature review is accomplished in the subject of Computer Assisted Language Learning (CALL). While most of the research conducted in CALL revolves around the learning of foreign languages, many of the learning principles can be adapted to learning Medical Terminology, which is the language of medicine, and in many ways can be considered a foreign language. This is an appropriate strategy since Medical Terminology utilizes significant quantities of word roots from the ancient languages of Greek and Latin.

CHAPTER TWO

LITERATURE REVIEW

Constructivism

The students from Humanatec Rehabilitation College in Yokkaichi, Mie, Japan, were placed in a situation where they needed to become independent learners to be able to complete the requirements to receive a Bachelor of Science degree in Health Science from Loma Linda University. Of many learning theories employed in education processes, one that is commonly used to support independent learning is constructivism (Jonassen, Davidson, Collins, Campbell, & Haag, 1995).

Constructivism highlights a method of instruction whereby the teacher guides the student to sources of knowledge empowering students to create their own knowledge. It is based on the premise that learners construct their own learning in their own minds (Jonassen et al., 1995) in relationship to meanings that experiences already impressed upon them. Collaborative learning and problem-based learning are hallmark features of constructivist learning, and provide extremely important opportunities for students to learn. Using constructivist methods, students are often clustered together in

investigative units seeking solutions to real life problems. This process helps students build their own knowledge and learn it more reliably. A by product of this process is that "students work and interact to become a community of scholars," (p. 7) and the teacher changes his/her role from lecturer to coach, moving from the front of the classroom to the sidelines of the classroom. This concept will be promoted as the students will be assigned to do independent research on medical subjects, write reports, post reports, and comment upon each other's work on Blackboard's (Blackboard, 2001) threaded discussion board.

A unique benefit to the collaborative learning process in social constructivist methods is that students build upon each other's learning by sharing their own personal knowledge and experiences, and therefore are able to learn from each other as well (Oliver, Omari, & Herrington, 1998). Additionally, and not to be minimized in the collaborative experience, is the process of partners keeping each other directed to the learning task. When the instructor moves to the sidelines, the student is given the appropriate time and place to build personal knowledge, but the student can also be tempted to take a rest and not learn at all. Student partnerships in

learning can encourage students to keep at their learning task and to also provide opportunities for learning from each other. The communication that takes place in collaborative learning relationships often involves higher order thinking and reflection, and frequently the learning processes are authentic to the student who uses real life knowledge to solve real life problems (Oliver, Omari, & Herrington, 1998).

For all the benefits that can be derived from collaborative constructivist learning, educators must fully realize the price that must be paid in extra time requirements for preparation activities (Oliver, Omari, & Herrington, 1998). Additional time is needed by the teacher for positioning students around their resource information, explaining the learning activity, downloading information from the Internet if web resources are used, systems crashes if computers are used, and students possibly spending extended times on certain learning segments while completely overlooking others. If extra time can be dedicated to collaborative constructivism, the results can be worth the effort and the process can generate an effective learning experience that ties in well to a related popular learning strategy, problem-based learning.

Problem based learning utilizes authentic or real life situations and puts students to work creating real life solutions. When constructivist-learning situations are authentic, they realistically resemble the usual activities of a culture (Jonnasen et al., 1995). Interesting and important problems of the culture are addressed and the students become engaged using organizational skills and their background knowledge. A number of technological products can assist students in seeking solutions in problem based learning such as databases, spreadsheets, semantic networks, expert systems, computer conferencing and emails, multi and hypermedia, and microworld learning environments. Technology is able to support shared knowledge that is so fundamental in social constructivist learning envitonments and necessary in seeking solutions to true to life problems. Technological resource information can be used as a means for students to randomly access those topics of most interest to them (Altun, 2000). It has been noted that when students research what interests them, and share that information in a technically based format, other students view, comment, and elaborate further upon the information (Oliver, Omari, & Herrington, 1998). A useful means of undertaking this process is participation in

research on the Internet (Oliver, Omari, & Herrington, 1998).

Focusing upon the strengths of constructivist learning, including constructing one's own knowledge, collaborative learning, and problem based learning, the creator of a distance learning experience can integrate these highly effective learning philosophies into a design that provides structure to assist the distant learner.

Instructional Design

The literature review on the topic of instructional design clustered around several different subjects. The first subject was the history of instructional design and how it evolved over time to meet the needs of instructors and students. The next literature cluster included many varieties of design techniques that have been used in education. Another category of instructional design literature related connections between instructional design outcome and the assumptions of the designer. Also in the literature, there existed many specific varieties of design, but other basic concepts seemed to be uniformly applied to all design, and these are discussed here under the heading of general instructional design topics. The

last issue of literature review is the subject of screen design for computerized educational projects.

History and Evolution to Current Trends

Prior to the 1960s, the instructional design community created most materials for instructional purposes based on a systems method of design, utilizing groupings of topics of learning content, which ultimately were put together to form the whole of the curriculum (Perez, Johnson, Fleming, & Emery, 1995). Strengths of system design were realized when users of the learning materials demonstrated ability to exhibit procedural knowledge and effective performance. But many criticisms of systems design also were also realized, including the assertion that systems design of educational materials was labor intensive requiring the creator to have a very high level of expertise in the subject matter (Perez et al, 1995).

Other efforts went into creation of other types of instructional designs. Updated principles of market and cost analysis investigated what types of educational design was most cost effective while meeting the needs of students (Bordeau & Bates, 1996). Topics such as student involvement with learning, media selection, methods of dispensing the information, and learning outcomes began to

be infused into instructional design, coming to a point of current usage which involves more of a mixture of styles rather than a single method (Hemard, 1998). As creators of instructional materials concerned themselves more with quality of their products and the learning experience of the student, student feedback, variety of learning activities, and access to many different types of learning materials captured more of the attention of instruction designers. The means of dispensing information expanded and broadened to include global participation in distance learning opportunities, creating even more instructional design challenges (Bordeau & Bates, 1996).

To meet a growing need for quality and distance delivery, constructivism worked itself to a prominent place in instructional design practice (Dick, 1996). A popular design model created by Dick and Carey in its original form actually featured systematic design. The model was redesigned many times to meet the needs of users employing new teaching techniques and evolving educational theories (Dick & Carey, 1996). Constructivism in design was revised over time to address current curricular requirements of technology and subject analysis, and Dick and Carey's model, among others, incorporated multiple

levels of analysis of the learning experience to promote continual quality improvement.

In distance education instructional design, even more challenges were faced. Designers grappled with instructional methods for distant students that attempted to avoid student isolation, prevent a decline in interest in the subject being learned, and provide ways that instructors could support their students in learning without meeting regularly in a classroom setting (Bordeau & Bates, 1996). Student learning outcomes took on enhanced meaning when students learned at a distance with the inherent obstacles that communicating from a distance brings. Instructors in a distance-learning environment were faced with a distinct and expanded organizational requirement in the design of their instruction (Thach & Murphy, 1995). Design practices of the past had to be adapted, reorganized, revised, and expanded to meet the current needs of learning communities. The design issues of today require rapid implementation to keep up with change in instructional methods, and undergo active analysis for effectiveness since extended time no longer is a luxury available to instructional designers to assess if their design methods work (Bordeau & Bates, 1996).

Various Design Concepts

Instructional design currently practiced often developed based on what was effective in a general way for many groups of students. Yet, other learning theories explain that learning processes occur differently for different categories and personalities of students. Is design affected by individual student differences in learning style? Further, is design affected by the differences in temperament of various instructional designers? Research has been done investigating the interactions that various students and designers have to the structure and form of instructional design.

One such study was conducted to assess how navigation through online learning resources was impacted by learner cognitive styles (Chou & Lin, 1998). The medium that was used for this investigation was a hypertext-learning course at the college level on the subject of computer networks. The students were studied as they participated in search functions throughout hypertext lessons. They were interviewed about what topics they selected for learning and what rational they used to search out information about topics. Students were also evaluated as to how successfully they were able to answer questions about the content of the information to ascertain how

accurate their search techniques were using the hypermedia lesson. An instruction and test booklet was used. The booklet consisted of a general introduction to the software with information on how to browse using hotkeys, "next" buttons, and maps. The booklet also contained a description of the procedures for conducting search tasks. Subjects had to following directions to find 10 particular subject content screens. A post-test was included in the booklet containing multiple choice and matching questions. All of the questions in the post-test assessed relationships among the content clusters in the course (Chou & Lin, 1998).

The conclusions were two fold. First, there was no significant difference in learning outcomes of students using variable search techniques, even though the students represented a marked variety in age and learning styles. The students were able to successfully arrive at the correct answers regardless of their differences in learning styles. Secondly, it was found that the organization of their cognitive processes prior to beginning the search technique in a hypertext lesson was significantly different. Different students approached the learning experience in hypertext in many different ways. However, the results of their search performance were

successful and uniform, despite their differences in cognitive organization and planning of the learning (Chou & Lin, 1998).

Another study evaluating the cognitive styles of active and reflective learners at the elementary level did show significant differences in performance in a hypermedia learning experience (Paolucci, 1998). When fifth grade students were studied using a hypermedia lesson on the subject of ecology, it was found that students with cognitive styles labeled as active, exploratory, and independent were able to perform at higher levels of learning outcomes than those students described as reflective. In three separate learning investigations, those students at the borderlines of passing scores were also students who came for frequent personal help from the instructor, asking for assistance in navigation and advice on where to find the learning resources on the Internet (Paolucci, 1998). One could hypothesize that Internet learning for young students requires higher levels of structure and scaffolding to support the independent Internet learning experience.

Another issue in instructional design related to variations in student learning styles pertains to a "mixed methods-pragmatic paradigm" (Henderson, 1996, p. 89)

asserting that the presentation of instructional material should occur in context of the cultural background of the students who are learning it. If instructional material is culturally appropriate to the students, it fits into the pragmatic paradigm (Henderson, 1996). For the proponents of this design theory, it is suggested that a member of the cultural group of the students could be a part of the instructional design team to serve as a source of reference and evaluation. Learner characteristics take on particular significance when designing materials for a selected cultural group. Use of a checklist at the design stage and at the evaluation stage containing all the significant issues pertaining to the culture might be an effective way of dealing with design issues for learners of a particular cultural group (Henderson, 1996).

In addition to the student's culture, assumptions about learning from the student perspective are another important topic that designers should address (Hemard, 1998). Student assumptions about learning may well be a result of the students' cultural background, but numerous other factors can affect how a student views the learning experience and how a student responds to materials that are used for instruction. The area of computer assisted language learning, which will be explored later in this

paper due to its connection with the learning of medical terminology, much has been written about students having difficulty learning from a technologically based medium because of its difference from traditional instruction. How a student views the instructional medium and learning process should be information that is important to the designer of the material and should influence how the design is carried out (Hemard, 1998).

Investigating the characteristics of the learning audience is a central function of the instructional designer. The attributes of the designer himself/herself should also be recognized as to how they can affect the outcome of the instructional design.

Assumptions of the Instructional Designer

In the field of computer assisted language learning, there appears to be a connection between the designer's learning attitudes, the materials that are designed, and the students' learning (Hemard, 1998). Many students today experience a degree of exposure to the Windows environment, word processing, networks, Internet surfing, and email, but they continue to be more strongly influenced by their traditional experiences with education that is a part of their past (Hemard, 1998). If the traditional learning outlook continues to be reinforced by

the designer of material, an opportunity may be lost for students to receive the benefits of meaningful learning that constructivism provides. In this author's opinion, the designer strives for balance to preserve what was excellent in learning in traditional settings with what is exciting and effective in newer concepts of learning.

One method for evaluating what is best practice in traditional learning, and how to design instruction to incorporate best practice, is to study the practice of a master teacher. Moallem conducted research on this subject by carefully and extensively evaluating the practice and thinking of a master teacher in the setting of her classroom experience (Moallem, 1998). To find this master teacher, criteria were selected which included: 1) the possession of an undergraduate degree in subject matter and a graduate degree in education or other subject matter; 2) no history of management or discipline problems; 3) minimum of seven years teaching experience; 4) good reputation among fellow teachers and students; and 5) excellent recommendation from the principal. The selected master teacher had characteristics which were unique, and therefore likely to be integral to her identification as a master teacher. For example, she modified the traditional classroom concerning peer

helping. She emphasized that in her classroom, peer helping was not cheating, and she encouraged student collaboration as much as possible. Students were allowed to help each other as much as possible in assignments, and yet each student was still required to submit individual work after the collaboration.

This master teacher felt that her own assumptions about learning and her past history of learning as a student herself had great impact on her current teaching practice (Moallem, 1998). She had her own personal history of problems with learning, spending the first year of school in a speech class of special education, and she was very influenced by her parents who supported her strongly through this trying situation. As a result, her current view of students is that students can learn and achieve if they put wholehearted effort into their learning, and she believes that students who do not do well in school often do not have strong family support at home.

This teacher's belief about what teaching should be is defined first by what it should not be. She believes that teachers should not be disseminators of information (Moallem, 1998). She feels teachers should be facilitators who help students find information. She recognizes what her own biases are. For example, she will omit certain

pages of the textbook for reading because she doesn't feel they are significant for learning. She never goes to Intelligence Quotient folders because she doesn't want to hear anything good or bad about students. In her own discipline, science, she feels science learning should not be solely a process of learning scientific facts, but instead a process of using scientific facts to solve real life problems. She feels science is a doing discipline (Moallem, 1998).

It is my opinion that successful instructional design should attempt to incorporate many of these instructional strategies of this master teacher. In using some of the newer features of technology integration, the designer should account for the fact that not all students will have the technology background or support from home to adapt to computerization readily. The designer should capitalize on the ways that material can help students find information and share information in a collaborative learning environment. Awareness of whatever biases the designer has about learning is important, as those biases will pervade throughout the entire production of the medium. Also, I feel the designer's current instructional practice and historical experiences with his/her own

learning will color the design and the carrying out of the educational program.

After analysis of assumptions about learning from both the student and the instructional designer, at some point, the design of the instruction must begin. In the setting of technologically mediated instruction with use of computers, I feel screen design plays a very important part. How students move through information presented on computers, particularly in a hypermedia and hypertext format, will be a central focus of this design plan. Incorporating exciting concepts of problem based learning, case based learning, and simulation makes the best possible advantage of what is new and helpful in instructional technology, in my opinion. The question then becomes how to incorporate valuable learning techniques into tangible instructional materials.

General Instructional Design Topics

In the field of technologically integrated instruction, several general principles of instructional design are suggested for development of learning materials that are valuable to the student (Hemard, 1998). Hemard feels one of the most important features of any instructional material is the degree of interactivity that students will experience with content of information

imparted by the materials. In the situation of computer based instruction, observation of students has shown that their forms of interactivity are variable, and designers of instructional material may want to incorporate a variety of ways that students can interact with material to open many avenues of approach to information.

Another important feature of general design in instructional material in a technically mediated setting is inclusion of processes that support the student in the learning experience (Bordeau & Bates, 1996). Issues such as student tutoring, meetings, conferencing and networking should be developed into the design to keep students on track and on target in their learning. Peer collaboration in the learning experience takes advantage of the strengths in constructivist learning (Jonassen et al., 1995). The feedback mechanism in technologically based instruction often requires significant detail in the design process given that the instructor may not be regularly present in the classroom for the student to ask questions (Bordeau & Bates, 1996). Designers may anticipate what errors the student may make in search processes so that they can create extremely clear links and directions. Also, as in any learning experience, evaluation standards for learning should be clearly

defined from the beginning, so that the instructional design can support the student in carrying out what is expected in learning.

To move from the general principles of technological instruction design to more specific design issues, I will now discuss screen design and navigation.

Screen Design

For instructional material that is intended to be presented on computers, the concepts of design as they pertain to layout on a computer screen take on particular importance. The use of visual symbolization as a means of instruction is suited to presentation on a computer screen, and for many individuals learning is most effective when visual input is a major means of acquiring new knowledge (Szabo & Kanuka, 1999). Visual and text presentation of information has been described as the dual encoding of information. The learner uses two distinct processes, one visual, and the other perceptual or verbal to acquire new information. In research, dual encoding has been linked to strengthened ability of the learner to acquire information and use it appropriately later when the information is needed. Visual representations in screen designs of instructional materials strongly support

the strengths of dual coding in learning (Szabo & Kanuka, 1999).

Established practice in instructional design has also included principles of unity and harmony in screen design based on the assumption that balance in design promotes the most effective learning of the content being presented. To evaluate this premise, learning outcomes of 52 adults who participated in a computer based learning experiment utilizing screen principles of unity, focal point, and balance were measured (Szabo & Kanuka, 1999) and compared to outcomes of learners using information presented with screen designs that failed to use these design principles. The results of the study indicated that learning outcomes were not significantly altered by presence of absence of established screen design principles. Poor use of design had no significant negative impact on learning outcomes, however it was noted that poor design did contribute to an increased amount of time required to instruct the students on the use of the information presented from the computer screen. Also, students required an increased amount of time to complete learning exercises provided in the poorly designed screens. While learning outcomes were not hampered by poor screen design, the time required to accomplish the

learning was significantly lengthened. To avoid excessive instructional and learning times being required for poorly designed screens, a more efficient learning environment can be created when the instructional designer incorporates good quality design principles of balance into the screen design (Szabo & Kanuka, 1999).

Navigation Through Hypermedia

Moving through computer-based instruction is a process that requires a great deal of consideration in instructional design. With the use of hypermedia in particular, a significant amount of research and commentary has been generated on the subject of navigation in attempts to understand how structure of information promotes constructivist learning while it guides and supports the student.

Hypermedia presentation of information supports the constructivist-learning principle of learner independent knowledge building and it has been shown to promote improved learning outcomes. One example of research supporting this assumption is an analysis and comparison of learning outcomes for content acquired by hypermedia compared to text presentation or videotape presentation (Liao, 1999). Hypermedia instruction was found to be

related to better learning outcomes compared to text or videotape instruction alone.

The specific strengths of hypermedia as compared to linear text are that its presentation offers random access of information to the reader (Altun, 2000) enabling the learner to be stimulated by his/her own interests. Flexibility in the delivery of information is possible in hypermedia, and this flexibility has the potential to add interest to the material being learned. Another advantage of hypermedia usage is its ability to incorporate multiple media easily and effectively. Text, audio, graphics, and animation can be used singly, or in any combination, to stimulate and saturate the learner with information in a variety of ways. This potentially adds interest to the learning experience, and also adds opportunities for a more complete learning experience by providing information through several different sensory experiences.

Another advantage of hypermedia learning, as suggested by recent research (Altun, 2000) is its speed of access. Hypermedia learners are very attracted to accessing information readily and quickly from resources available on their computers. It is reasonable to assume that all learners will opt for the more rapid access to information from computers if that information is of high

quality. On the other hand, obstacles to learning do exist in hypermedia in the area of rapid retrieval. When computer design or other technological factors interrupt the retrieval process, users experience frustration which if excessive can hamper the usefulness and popularity of hypermedia as a learning method (Altun, 2000). It seems reasonable to conclude that a theme overriding all instructional design should be the ease, efficiency and speed of access to the information. Thought and evaluation of this process in design ensures that the learner's use of the material is enjoyable and successful.

If hypermedia is selected as the method to provide information, the strategy to navigate the hypermedia becomes a crucial design issue. Falling back on skills for accessing traditional text material seems to provide little help to students who are relatively new to the hypermedia environment (Lidstone & Lucas, 1998). Specific research evaluating graduate level students accessing hypermedia and multimedia information about the subject of ethnographic research demonstrated interesting findings. The students had little or no previous hypermedia experience, and they found that the time and effort spent searching out the information on hypermedia took more of

their energy than what was actually spent learning the information.

In a computer based learning format using hypermedia, information can be presented in a number of ways utilizing a variety of navigational methods to steer through the segments of information (Evans & Edwards, 1999). Information can be presented in a linear fashion sequentially, and the learner has only one option in navigation, to pursue the information in a guided one-directional fashion. In linear approaches, only one path in one direction is followed. A multidirectional approach to knowledge acquisition in hypermedia utilizes the hierarchical or tree approach. This approach contains many different directional approaches, and the user is not forced into only one path, but in this structure, there is an implied sequence of priority in presentation that is suggested to the learner.

Generally in the hierarchical approach to acquiring information, the method for transfer to the next informational segment is by using a link, and usually when screens are designed in this fashion, two links for each screen shot are created (Evans & Edwards, 1999). One link is created for the next instructional page, and one for the previous one. A third directional technique in screen

design for access to multiple sections of information is the information map. The map provides directional access to the learner without any limitation. The learner can select any direction that is desired without guidance from the instructional material. Choice of direction is solely related to the learner's interest (Evans & Edwards, 1999).

The link is the basic unit of navigation in hypermedia learning. The astute designer recognizes the crucial nature of this important feature and the potential obstruction to the learning process if link design is not done optimally (Altun, 2000). A good quality link is easily noticeable and attractive to the learner's eye. If the link escapes the attention of the learner altogether, content information will not be followed (Altun, 2000).

With reference to the various approaches available to learning in hypermedia, and attention to the importance to how educational segments of information can be accessed through links, the choice of which approach to include occurs in the planning stages of instructional design. Evaluation of learning outcomes of users has been performed to evaluate the differences in learning outcomes of students who used conventional linear methods, hierarchical methods, and branching methods. Branching methods did reveal significant advantages for users

(Paolucci, 1998). Branching is defined as the learner's ability to select destinations of learning segments in any number of alternative paths without constraints. In tests evaluating learning outcomes in hypermedia, branching groups performed significantly better in comparison to those users who accessed information linearly or in hierarchical pattern. These improved outcomes were experienced both in total performance and in performance in higher order cognitive skills.

The strength of branching appears to lie in the fact that it allows the user the freedom to pursue whichever direction of learning is desired, while at the same time maintaining a certain structure to assist the learner in knowing what has already been accessed and learned, and what remains undiscovered (Paolucci, 1998). In the research that demonstrated higher learning outcomes, observers of the learners reported that learners using branching were engaged and focused. Whether this interest had any relationship to the improved learning outcomes remains to be proven, but it seems reasonable to assume that learners who approach learning based on their own interests would likely learn more efficiently and effectively.

One feature that is unique to the branching function in hypermedia is the documented problem that some learners have of getting lost in the hypermedia or becoming overloaded with excessive amounts of information in one learning episode (Zhu, 1999). This circumstance was studied at length in a hypermedia research exercise in reading and comprehension. Participants were college students in the Midwest, and as the students navigated through hypermedia using various quantities of links in their searching, they were rated for learning outcomes and for attitude. Investigation took place regarding the number of links in a hypermedia lesson and its relationship to learner disorientation and cognitive overload. The results concluded that learners who navigated hypermedia with fewer links were able to perform better in learning outcome assessments than students who approached the learning experience using several links (Zhu, 1999). Not only were the outcome scores higher in the fewer link group, but the users experienced a more positive attitude about the learning experience as well. From the results of this study, the designer of instructional media may wish to adopt a simpler and focused design of learning material limiting the number of

links in the presentation of information to prevent learner disorientation and cognitive overload.

General computer instructional design issues and specific topics of screen design and navigation have been reviewed. How can these mechanical issues of design incorporate valuable learning practices of constructivism and problem-based learning? Exploration of this question will now take place with a review of problem based learning in hypermedia.

Problem Based Learning in Hypermedia

Problem based learning has been identified as an educational process that is well suited for technologically mediated instruction (Jonassen, 1997). How technology supports problem based learning is considered in the design process. To discuss problem based learning, it is beneficial to begin with one explanation of traditional learning as described by Jonassen and then move to current learning theories in problem-based learning.

Jonassen describes traditional learning as an instructional process utilizing well structured problems (Jonassen, 1997). Well-structured problems are most commonly used in schools and universities, and follow traditional textbook presentation of information and

problem solving. Well-structured problems require application of rules, which lead to a probable solution. The rules themselves are well structured, and are involved in one recommended solution that leads to one clear correct answer. In contrast to well structured problems, is the ill structured problem that is related to the concept of problem based learning. Ill structured problems are every day problems and they are generally ill defined because the elements of the problem are unknown, the goals of the problem solving can be vague, there may be a number of possible solutions to the problem to be undertaken, and the final answer may be able to be evaluated under many different evaluation criteria (Jonassen, 1997). Ill-defined problems require the participants to think using real life concepts and criteria.

While problem based learning is being touted as a most authentic and engaging form of learning for students because of its real life importance, most instructional design models fail to include it in learning objectives (Jonassen, 1997). It is recommended that future design of instructional experiences contain the problem based learning method in addition to practice of well defined problems in traditional learning, for a more complete learning experience for the student that will include a

variety of cognitive components including networking, motivation, and engagement in the learning process.

One particular form of problem-based learning that is receiving attention in instructional design is case study (Kinzie, Hrabe, & Larsen, 1998). Case studies are particularly suited for problem-based learning that can be provided in technologically mediated instruction because they are real problems, they require research, and they provide material for discussion, which provides a setting for collaboration (Kinzie et al., 1998). Cases have other excellent characteristics as well. They provide opportunities for learners to practice analysis and they generally stimulate learners due to their real nature. Research confirms these advantages. In a graduate student study evaluating the case method, collaboration was actively pursued, discussion was optimized, consensus was reached and decisions were made (Kinzie et al., 1998). In this particular research exercise, the conductors of the experiment used the Internet extensively in the case presentation, which was an effective strategy. The Internet was extremely beneficial as a means of distributing information about the case to all participants, who took advantage of the ease of accessing

information and reviewed the information prior to discussing with peers.

Another method of participating in case based learning in a technologically mediated environment is through computer simulations. Educational simulations offer several learning opportunities to the student supported by a problem-based technologically mediated environment (Harper, Squires, & McDougall, 2000). In simulation, learners have the ability to experiment with their learning, thereby avoiding potential damages or costs. Simulations provide the learner the opportunity to go about solving a problem in a variety of different ways, comparing which methods generate best results. Simulations portray the learning environment in a complex, representational way. This promotes an interesting and engaging learning environment for the student and stimulates the student to learn problem-solving techniques in useful ways prior to solving the problem in real life.

Keeping in mind the recommended features of general design principles, screen design, and navigation, the design effort can go forward integrating design into the latest education theories of effective instruction such as problem based learning, case based learning and simulation. After the design is planned, and at a point

before actual creation of the design takes place, evaluation of the design process is a logical next step in my opinion, to assure that the creation of the educational material is at as high a quality level as possible. One method of conducting this evaluation is to look for common design pitfalls that educational material designers have encountered previously.

An evaluation criterion might be awareness of the inherent limitations in design in instructional materials. While instructional design is an extremely complex process, reducing it to a mere listing of procedures defeats the purpose of a learning episode (Moallem, 1998). Moallem recommends that designers should keep in mind the intricacies of the learning process as they plan out and conduct the design, and bring their level of thinking to a higher order as they address problems in design that guide the potential learner through the problem solving steps of constructivist and problem based learning.

Coupled with the demands of creating instructional designs sophisticated enough to meet the demands of challenging problem based learning environments, the designer must also meet the needs of learners who come from a variety of learning skills and experiences with technologically integrated learning materials (Hemard,

1998). Recent research continues to demonstrate a significant amount of students who feel their computer activity and experience is minimal, and who experience discomfort with the use of computers in their educational environments. The intensive effort to provide computer exposure as a daily process of early education began only recently in schools, and this exposure is still not universally provided to all students in this author's teaching experience. There still remains a gap of a few years before students with early exposure to computers will find themselves in the secondary and college learning environments where complex technologically infused curriculum using constructivist and problem based learning is integral to curriculum. And that gap may further continue if issues of the digital divide persist, with computer access and usage variances based on family income and education levels (U.S. Department of Commerce, 2000).

To thoroughly evaluate how the existing body of knowledge impacts technologically integrated instruction, investigation of negative aspects of design must also be accomplished. Documented instructional design obstacles have been reported in literature, and will be outlined here.

Stumbling Blocks in Instructional Design

Another concern of the instructional designer is how to avoid stumbling blocks in design about which students frequently complain (Paolucci, 1998). These mechanical features of design which can cause trouble for learners are problems such as color schemes that distract, implementation of poor quality or vague types of graphics, unorganized overall design, references that are not clearly connected to the content of the information to be learned, and in a hypermedia setting, lack of potential resources, such as failure to connect online learning to multiple excellent online resources available for students (Paolucci, 1998). Moreover, in the design phase, care must be taken to present information clearly in a way that assists students in moving through the information with ease. Much research has described the struggle and dissatisfaction that learners can experience with materials in a hypermedia environment that distracts them, gets them lost, and frustrates them (Paolucci, 1998). The freedom that promotes interesting learning in hypermedia must be carefully structured to help students in deciding which educational segment of information to pursue in a hypermedia search. Focusing on the content of information in hypermedia is the objective the designer must set for

his potential learners, and in hypermedia a requirement of vigilant attention to clean design must be undertaken to achieve this objective.

This topic of clarity in design and structuring of information in hypermedia takes on increased meaning when developing materials for the purpose of distance education. The frustration a student may face in disorientation in hypermedia in the classroom is correctable by an instructor who is proximal to the student, but in the distance-learning environment, the student will probably have no such helper close at hand (Thach & Murphy, 1995). Compounding this challenge in design is the additional difficulty of designing instruction that is compelling and interesting to a student who is separated by time and space from a teacher (Bordeau & Bates, 1996). When real time communication with a teacher while the student participates in a distance-learning environment is not always an option, as in the case of web based learning, the instructional design process must capitalize on those features of design that can promote motivation and assistance in the learning process in other ways.

Motivation in a technologically based learning environment or through distance education can occur in

several ways (Bordeau & Bates, 1996). The creation of learning activities within the instructional segments is a crucial requirement for keeping the student engaged. To promote collaboration, and to minimize the effects of a teacher not being available in a classroom, collaborative projects can be woven into the design of the instructional unit (Jonassen et al, 1995). Ongoing evaluation of the learning process is integral to continually improve the design of the instruction, so the designer should develop ways that instructors using the material can actively measure learning outcomes (Bordeau & Bates, 1996). As new information is learned about how to improve the instructional process, the ease in revising the material will play an important part in updating and improving the material. Potential for revision should be a key consideration in instructional design.

The instructional designer should also address practical features of usability of the instructional materials (Bordeau & Bates, 1996). Are the materials in a medium that students can easily afford and enjoy using? Is the medium for presentation conducive to education? Within the instructional material itself, are instructions for usage clear and readily understood? The promotion of ease of navigation and searching capability in learning

materials can be established by providing clear directions on the use of the product on each screen of instruction within the material.

Design Evaluation

A formal evaluation of the design of instruction is integral to the design process. The designer can assume multiple roles as evaluator of design, or s/he can invite participation from outside evaluators for feedback from a variety of sources. Roles that can be pursued in this process are evaluator, critic, and reviser (Weston, McAlpine, & Boronaro, 1995). The creation of specific tools for use in the evaluation process is useful for a reliable and thorough evaluative process. The evaluation process should first focus on the objectives of the learning experience, and then the learning outcomes to assess if objectives were met. Tools such as pretests and posttests are useful in making such determinations. These tools assist the evaluator in collecting data pertaining to the learning process. Feedback from this information is assessed and from information gleaned, modifications to the instructional process can be made, followed by ongoing evaluative processes. The never-ending process of evaluation is incorporated into the design process.

To continually improve the learning process, Walter Dick, a coauthor of a noted instructional design model in use in educational circles today feels that a mixture of what is known to be effective from the past and what will be discovered in the future will affect design practices in the future (Dick, 1996). Continual evaluation relates to unlimited change in instructional design. Evaluative process of design will be central to this ongoing process. Dick feels that preassessment work with learners will change slightly in the future to adapt to future learning environments based on the changing nature of learning. He feels what future learners will bring to the learning experience will take on increased meaning to education in general and instructional design in particular. Dick suggests that changing words from "Identify Entry Behaviors and Characteristics" to "Analyze Learners and Contexts" (Dick, 1996, p. 58) will prepare designers for the complexities of designing instructional material in the future.

Specific information pertaining to curriculum content and presentation formatting is integral to the instructional design process. In medical terminology instruction, learning theory applicable to language

learning is appropriate and will be addressed in the next segment of this paper.

Computer Assisted Language Learning

As the design phase of an educational product goes forth, attention to the specific needs of students and the requirements of the curriculum need to become a central part of the design process. In this project planned for distance instruction in Medical Terminology to occupational therapy students in Japan, the subject of medical terminology is viewed as instruction in a foreign language, the language of medicine. I feel this philosophy is supported by the fact that the origins of most medical words are Greek and Latin word roots. Therefore, principles of design as they apply to foreign language instruction will be investigated here. More particularly, attention will be paid to computer assisted language learning research, because in this circumstance of distance instruction to students in Japan, heavy use of technology will be part of the instructional strategy.

Use of CALL has evolved in two specific directions in language learning, CALL instruction in grammar, and CALL instruction focusing on communication (Holland & Kaplan, 1995). CALL systems that have focused on communication have minimized focus on grammar and instead emphasize

student usage of language. In the setting of instruction in medical terminology, grammar takes a very minimal role in the learning of the language. From my experience of 26 years in health care professions, medical terminology is used as a means of documenting scientific information about patient disease and treatment. It is brief, focused, often abbreviated, and common usage avoids grammatical rules for the most part, emphasizing instead, whether the information is clearly understood by multiple members of the health care team. Accreditation bodies of healthcare institutions in the U.S. and around the world inspect medical terminology in medical record documentation for its clarity and understandability (Joint Commission on Accreditation of Healthcare Organizations, 2000; Abdelhak, Grostick, Hanken, & Jacobs, 1996). Using these accreditation bodies' standards as a benchmark, learning objectives for the instruction of medical terminology focus on communication. Therefore, creation of instructional material for the subject of medical terminology should focus on communication (Henderson, 1996). With communication as a focus, fluency in language is an important objective in instructional design.

Before designing the Medical Terminology instructional project, review of learning theories of

language acquisition is pertinent in order to keep in mind what instructional strategies support language acquisition. There are basically two philosophies that are popularly practiced for acquisition of language (Ellis, 1995). One theory is the implicit process of acquiring vocabulary, which asserts that a learner acquires a meaning of a new word unconsciously as a result of repeated exposures to the word in context. The explicit theory, on the other hand, explains that the learner acquires new vocabulary through a variety of cognitive strategies including recognition that the word is unfamiliar, attempted translation of the word from context, and consolidating the new word into usage by association with other words and concepts. According to language theorists (Ellis, 1995), both theories are true. Therefore, the instructional designer of instructional materials for the subject of language learning could create a comprehensive learning package by including the presentation of new information in a variety of ways, emphasizing implicit and explicit language acquisition with the inclusion of practice exercises to reinforce usage of the newly acquired word.

Language experts have recommended several techniques to bring exposure of language under implicit and explicit

conditions to learners such as use of inference from context, use of dictionaries, high probability sequences, scales (such as cold/warm/hot), card indices, and guessing skills (Ellis, 1995). All of these methods are amenable to inclusion in instructional design, and have a place as well in technological design of instructional material. While the potential advantages of incorporating these resources in instructional material are recognized, the requirements for providing complete resources needs to be assessed before embarking on such a design adventure. For instance, it is recognized that dictionaries are a highly useful resource for learners of new languages, yet language experts feel that the average dictionary contains 50,000 entries (Henderson, 1996). Can the designer provide all the useful materials that a learner can benefit from, or if not able, perhaps the designer can guide and direct the learner to sources where these sources of information are already present. These are important design issues. While both implicit and explicit methods are used in language acquisition, previous research has suggested that most new words are learned through implicit means. It therefore seems reasonable to provide most language design via implicit methods. Nevertheless, explicit study of words is necessary for all learners and cannot be ignored

for proper application of the word in usage (Duquette & Renie, 1998). Many experts feel that the mixed approach in language learning is the most effective teaching approach.

Language learning has promoted collaborative learning for several years as a highly effective way of assisting students in language acquisition (Renie & Chanier, 1995). Instructional design for language learning should not overlook this value of collaboration as a most effective technique to incorporate constructivist learning. Ongoing investigations into the subject of second language learning yield results that continue to promote collaboration as a particularly efficacious language learning strategy. Peer interaction with language learning material can increase the students' awareness of the sociocultural aspect of the language, promoting fluency. Collaboration also requires the learner to put to use the knowledge s/he already has, connecting the learner to the real world application of the knowledge, and using the knowledge first in an interactive way with another learner.

Another successful technique in language acquisition is the practice of key words in learning and the presentation of new words in multiple contexts (Ellis, 1995). Research subjects who used keywords in language

acquisition were found to perform better in new word translations than learners who did not utilize key words for acquisition of new terminologies. Other outcome-oriented measurements of competent language acquisition have assessed the method of instruction in multiple contexts. In a research setting, improved learning outcomes were demonstrated for those learners who were presented information in multiple contexts in comparison to learners who received information in single contexts (Ellis, 1995). Based on these findings, instructional design integrating key words and multiple contexts would appear to be a development strategy linked to successful learning outcomes.

CALL has been noted to have a particular strength in reinforcing automaticity in the learner by promoting language recall for new terminologies that have been learned (Segalowitz & Gatbonton, 1995). In the discipline of language automaticity, the speed by which the learner can recall newly learned information correctly, a desired objective is fluency. Language learning theory asserts that if the learner's terminology recall is automatic, the learner will have increased amounts of attention to deal with other aspects of language fluency such as information integration, planning future responses, and mental

processing of phrases and clauses of meaning (Segalowitz & Gatbonton, 1995). Computer assisted language instruction is well suited to be used as a medium for rehearsing the learner in automaticity of language. Studies regarding language fluency highlight the fact that highly fluent participants in language also demonstrate highly automatic word translations and consistent practice patterns of word acquisition over time. To use computer-to incorporate theories of constructivism and computer assisted language learning in this learning project, presentation of information via multiple media is a design strategy that can be explored. Next, the subject of multiple media will be discussed as it relates to instructional design and effective learning outcomes.

Multiple Media

The strengths of CALL can be supported by the inclusion of multiple media in instructional design. In language learning, it has been postulated that one way that learners make meaning of new words being learned is to form mental models or semantic maps of what the new word represents. Mental models are described as a "structured and functional representation of knowledge" (Hemard, 1998, p. 249). One investigative study indicated that language learners actively used mental models, and in

fact, when models were suggested to them in tight, moderate, or loose connections to the new word being learned, more than half of the investigated group preferred tight mental model representations to assist them in learning new words (Henderson, 1996). To use mental model depictions, a learner mentally registers the information that has been presented to him/her following the process of search, recognition, and inference to put meaning to the new word being learned.

Students learning new material commonly employ mental models, but analysis has shown that students often are inaccurate and unreliable in their formation of models (Hemard, 1998). Mental models have been known to lead to incorrect interpretations of new information and can generate vague and incorrect conclusions. This fact is a concern in development of instructional design. Erroneous or not, mental models continue to be utilized by learners to assist them in their acquisition of new information. A common method of mental model design that can assist students is the creation of visual representations next to the text presentation of information of new words that are to be learned (Henderson, 1996). Visual representations actually provide a strong connection with text information for learning and recall purposes, and are used quite

actively in instructional design. This practice is an example of the theory of dual encoding in learning which is the process of providing information in more than one mode of delivery. Dual encoding has been linked to improved learning outcomes as previously described in this paper. It is theorized that dual encoding is so powerful in language learning because it causes the establishment of more than one retrieval route for the information user (Chanier & Selva, 1998). Also, it is felt that more than the usual amount of information can be stored in dual encoding because multiple and distinct areas of information storage in the brain are utilized.

The theory of dual encoding is hypothesized to be the main reason that multiple media work so successfully in language learning (Bagui, 1998). In dual encoding, information is processed by the learner through independent channels of verbal, visual, or other perceptual input (Szabo & Kanuka, 1999). Various multiple media provide various independent vehicles for information dissemination. In multiple media, information is gleaned via multiple routes before being processed and stored by the learner in long term memory. Another advantage to the input of data via multiple senses as obtained through multiple media is that the learner is able to break the

new information into multiple chunks. According to multiple chunking processing theory, learners have the ability to hold up to seven chunks of information in their short-term memory at one time (Szabo & Kanuka, 1999). This theory of multiple chunking can relate to multiple media presentations in hypermedia which enable learners to take in as little or as many chunks of information as is desired.

It is suggested that multimedia presentation of information in a hypertext presentation actually is efficient to the learner because of the information is open to selection according to the learner's choice (Dee-Lucas & Larkin, 1999). In hypermedia, the learner has the ability to select only that information which is important to learn to meet the learner's own specific objectives. Students can overlook entirely those segments of information that are already known, or that do not met the learner's specific learning objectives. To support this selective learning function, design must incorporate extensive structure in the instructional material (Dee-Lucas & Larkin, 1999). Structure clearly guides the learner in the path that will take them to their desired learning objective. Without a high degree of design clarity, the learner may spend excessive time in searching

and navigating, defeating the usefulness and efficiency of the hypermedia learning format.

Multimedia is extremely useful in computer language learning and supports many learning theories with effective and efficient techniques for learning. Nevertheless, using multimedia technology as it exits today is not without its limitations, and the astute instructional designer must be cognizant of these limitations. First of all, multiple media requires heavy data storage, and high levels of computer power are often necessary for the multiple media to operative at its peak efficiency (Diaz, 1999). For users with limited computer power, this requirement can become a liability, especially when accessing multimedia on the Internet. Delayed access or interrupted access are often experienced by users of multiple media on the Internet, which is a very frustrating experience for students and instructors who have already begun to participate in web-based instruction. The audio, visual, and animation features of multiple media often are slow to operate, so the advantages of their use may be outweighed by the frustration a user feels unable to move through multimedia work rapidly (Diaz, 1999).

It has been postulated that at least a partial solution to the problem of slow multimedia operation might be a combination usage of Internet and CD ROM, since the current state of CDs now allow for rapid access to information (Diaz, 1999). This idea is excellent for rapid access of information, but has its detraction in that CDs are limited in how rapidly they can have their information updated to new information if the need arises. Also, it is my experience that CDs may not be as common a mode of instructional presentation in the future as they were in the past. For instance, Loma Linda University has recently upgraded its computer labs with new PCs and intentionally selected models without CD ROM drives for security reasons. In the past CD users in university computer labs loaded their own personal software via the CD to the hard drives of the computers, thus making the machines sluggish and difficult to use. As a solution to the problem, CD ROM drives were removed, and the labs provide all information via network or Internet connections. If this situation continues on a widespread basis to other schools, Internet CD hybrid delivery of instructional information would not be a viable solution to the problem of slowly operating multimedia.

This review of literature has outlined recent information on constructivism, instructional design, computer assisted language learning, and multimedia. To incorporate this body of research into the design phase of Medical Terminology via distance instruction to students in Yokkaichi, Japan, a careful plan was designed to integrate the known strengths of computer mediated language learning to the learning experience for these students. The plan for the design of this instructional project will be discussed next.

CHAPTER THREE

DESIGN PLAN

Design Based on Learning Theories

Based on review of the literature, I feel several key design features are crucial to the design of a web-based exercise project in Medical Terminology. My intent is to connect all features of design with established learning theories in education, thereby making the design of this project a process of grounded design. Grounded design as described by Hannafin and others, assures that methods of design are related to established foundations of educational practice (Hannafin, Hannafin, Land, & Oliver, 1997). In this web-based project, features of design should relate to the unique presentation of learning concepts via a technologically based medium. The design will incorporate concepts of dual encoding, effective screen design principles, interactivity, navigation, constructivist and systematic learning processes and design, feedback, and evaluation of the instructional project.

Distance Education Competencies

Another focus of attention in the design of this learning project is the recognition that instruction to students at a distance presents unique challenges, skill requirements, and course management practices as compared to traditional classroom instruction. It has been suggested that the distance instructor actually has separate and distinct competencies (Thach, 1995) that are outlined below. Distance education is different from traditional instruction in this medical terminology course for Japanese students. The students are separated from the instructor by geographic distance, and the major form of communication between student and teacher will occur using two-way interactive television. Heavy reliance upon traditional classroom lecture may not strongly support these methods, and instruction techniques will be adapted.

To support effective distance education, the instructor must possess certain competencies that are unique to distance instruction (Thach, 1995). Because distance education via the latest technological advances is relatively new in educational practice, information on what constitutes a distance education competency has been obtained from interviews of experts in this area of

education. A common opinion among experts about what constitutes a distance education competency focuses upon interpersonal communication and learner feedback. When education is mediated by distance and technological delivery, activities such as praising students, calling them by name, and providing individual student feedback take on even more importance than before, according to Thach (1995).

Another area of great attention and focus in distance instruction is administrative skill because a greater amount of preparation, organization, and planning are required to bring about effective education at a distance (Thach, 1995). Thach also believes the distance instructor needs to hone skills in teamwork functions because heavy reliance upon technology staff of an educational institution occurs for technical support to keep educational tools working.

Underlying the construction of this design process is vigilant attention to connecting all design methods to established educational theory. The importance of this connection between design and theory may not necessarily ensure improved learning outcomes for students, but it has been suggested that grounded systems better aid designers

in seeing the ambiguities of their design (Hannafin, et al., 1997).

I will next address the theory of dual encoding and how it will be grounded in the design process.

Design Incorporating Dual Encoding

Dual encoding, the process of learning new material using two distinct mental processes emphasizes the importance of the learner being able to receive new information via mental verbal systems, mental visual images and other perceptual inputs (Szabo & Kanuka 1999). This process can facilitate learning and enhance memory of newly learned material. Dual encoding theory is central to the development of this particular web-based learning exercise for two reasons. I feel it supports a more effective learning process and is well suited to learning the language of Medical Terminology, which requires extensive memorization of many word parts and word roots of Greek and Latin derivation. Also, the quantity of new information to be learned is often one of the most challenging aspects of learning medical terminology, as reported by my previous students. I feel dual encoding should help the student learn more effectively this large body of information.

Additionally, the concept of dual encoding will be taken a step further here, to include not only verbal and visual presentation of ideas, but also audio presentation of the correct pronunciation of medical words. I anticipate that all three methods of presentation should enhance the learning process. The textbook that the students in Japan will use is supplied with supplemental audiotapes that can be played in a recording machine, and the students are given listening assignments. But enforcing these listening assignments has been difficult even in a local classroom because of lack of time to send students to a listening laboratory. Presenting pronunciations on the Internet with verbal and visual clusters of information to augment the sound files hopefully will attract student participation and invite them to spend more time learning correct pronunciations than previously occurred.

In my opinion, medical terminology instruction on the Internet will be more effective by employing dual encoding. Multiple media can strongly support dual encoding in technologically based instruction, as Brett suggests, as evidenced by increased student learning, student enjoyment of the learning process, improved listening comprehension, and use of visual cues to support

learning (Brett, 1998). For these reasons, the design of the learning project is centered upon the learning theory of dual encoding, and multiple media are used throughout the learning project as a means to deliver content.

Design of the Screen

To provide a clear, clean, and attractive presentation of learning ideas to students in this project, theories of screen design will be utilized and included in every segment of the learning project. It is hoped that a high quality of presentation will contribute to a student's use and enjoyment of the instructional project. According to Szabo and Kanuka (1999), three primary screen design principles can contribute to high quality of presentation. These principles are unity, focal point, and balance. Unity is achieved in this project by designing a template for presentation of new content throughout the entire project. More discussion concerning the presentation templates of this project will take place later in this paper. Focal points are the areas the student will focus their attention for learning. In this project, the focal points will tie directly to the dual encoding principles of text presentation of new information, visual cues, and audio files of correct

pronunciation of new medical terms. Multiple media will attract and focus the students' attention to the focal points of the learning experience. Balance, the last of the three screen design principles (Szabo & Kanuka, 1999), will be achieved by limiting each knowledge cluster to a brief, circumscribed content for easier student learning. These clusters will be created in such a way so that they easily catch the students' attention, are pleasing to the eye, and are limited to avoid cognitive overload. The use of the design template will contribute to project unity and the use of focal point and balance in this learning project.

Interactivity is another key concept in instructional design that I wish to incorporate in that the degree of interactivity of the learner with the learning material will likely relate to how much learning will occur (Najjar, 1996). If the student doesn't interact well with the material, anticipated objectives of the learning experience will not be met because the student will simply not work with the material. Careful attention in design to frequent interactivity by the student will help ensure that the learning materials are fully utilized (Lidstone & Lucas, 1998). However, research has also shown pitfalls of learning projects with poor interactivity. Lidstone and

Lucas reported a study of graduate students using multimedia-learning projects who were new to specific demands of multimedia education. These students spent more time trying to master the technology then they spent with the content of the program. With this in mind, I designed this learning experience to contain easily maneuvered multiple media, all accessed by hyperlink clicking by a mouse. The navigation of this project was designed to promote easy student access.

Student Centered Design

My objective throughout the development of this project was to center the learning as much as possible to the needs, desires, and learning styles of the student. This project was not designed to be the sole means of instruction for this course, but rather a useful adjunct to textbook and personal instruction to the students using synchronous audiovisual equipment. Because these methods of instruction are teacher driven, the web-based learning project itself is designed to be student driven. The student centered nature of this project benefits from the use of multiple media, which has been described previously as a student centered form of instruction (Crosby & Stelovsky, 1995).

Student centered learning promotes the benefit of promoting constructivism with emphasis on the student's construction of his/her own personal meaning to the concepts being learned (Hannafin, et al., 1997). The objective of improved learning outcomes for students hopefully will be supported by the use of multimedia (Crosby & Stelovsky, 1995). Whether or not performance scores increase, some theorists feel that student interactivity with the multimedia instructional materials will be increased (Najjar, 1996). I anticipate increased student interactivity with multimedia will relate to a positive student opinion of the learning project.

Overlying all construction of this educational learning project in medical terminology was my principal concern of making all components of this exercise easy to access. I wanted the student to be able to move freely from one knowledge cluster to another. I felt it would help enhance the learning experience to ensure that all important concepts of each learning segment were scaffolded so the principles of Systematic Design, as outlined by the Dick and Carey Systems Approach were incorporated (Dick & Carey, 1996). The specific steps followed to incorporate systematic design are described in the section of this paper entitled "Applying Medical

Terminology Content to the Project." In addition to systematic design, I incorporated processes of constructivist learning as well, because constructivist environments, as described by Jonassen, support the student in making learning meaningful (Jonassen, 1997).

Animation

Another important factor in the design of this project was student freedom, not only to navigate as desired, but also to spend as much or as little time as desired upon each learning cluster. One of the strengths of computer based multimedia instruction is its ability to allow the learner to personally set the pace of the learning activity (Najjar, 1996). This is something that cannot happen in traditional classroom instruction which is teacher driven. Therefore, the timing of the presented material was designed to allow the student to move through the material at his/her own pace. The only exception to this occurs in the use of animation for the presentation of new terms to be learned. My purpose for using animation was twofold: 1) To help the student identify which terms are already learned, and which terms still need to be learned to achieve fluency, and 2) To assist the student in self assessment as to whether the recall is rapid. The

exercises were designed to promote automaticity in recall, the desired outcome of translating the medical terms rapidly, thus allowing the student the opportunity to expend more time on interpreting challenging word parts in language usage (Segalowitz & Gatbonton, 1995). To promote automaticity in the learning process in this web based project, the animated presentation of terms to be learned was designed at one-second intervals. If the student is not able to rapidly define the words within one second, s/he is encouraged to restudy the term until that speed of recall can be achieved. I feel one-second recall is appropriate based on my own 26-year experience working in health institutions.

Design Utilizing the Internet

Another desirable feature of technologically based instruction is its potential use of the Internet to promote authentic meaning to learning for those who connect to numerous web-based sources of useful information (Jonassen et al., 1995). A feature of the courseware Blackboard (Blackboard, 2001),, which is used for the presentation of this project, is the section of the software for "Links". In this area, the instructor can place Internet websites that contain information useful to

the student. Students can flexibly search these websites, and the desired student centered nature of this learning project is promoted. The link itself is created to guide the student to an expanded knowledge base of a complex nature (Jacboson, Maouri, Mishra, & Kolar, 1995). This guided linkage assists the student in avoiding detours to vast amounts of information on the Internet which may not be meaningful.

The creation of Internet links in the learning project enables the student the opportunity of extended and continuing learning which is considered to be a successful learning process by many educational experts (Hannafin & Land, 1997). In the field of medicine, which is constantly changing, I feel the ability of the student to continue and expand learning is not only desirable, but rather is considered necessary. Expanded learning from the Internet is a prominent feature in the design of this web-based resource in Medical Terminology.

Navigation Design

Navigational strategies are developed to support both systematic design and constructivist learning. Systematic design incorporates identification of instructional goals and objectives, development of criterion references,

development of instructional strategy, developing instructional materials, and conducting formative and summative evaluations (Dick & Carey, 1996). Constructivist learning is based on the premise that students construct their own learning in their own minds (Jonassen et al., 1995). Template development and eventual screen design will help ensure that features of systematic and constructivist learning and design will be addressed uniformly throughout the entire design of this project. There will be sequential or linear presentation of concepts to communicate to the student the entirety of the content that s/he is expected to learn in a step-by-step fashion. There will also be systematic presentation of information in this project is by bulleted lists on screens.

Constructivist principles of learning will be supported by the project hypertext links. Hypertext links will promote this philosophy of learning because the student will be able to pick and choose which concepts to learn, building upon what is already known. Previous research on hypertext presentation of information reports that students presented with highly segmented hypertext generally select links that are most important to them (Dee-Lucas & Larkin, 1999). Henderson also felt that this

ability of the student to move freely through content of information supports learning processes (Henderson, 1996). Hypertext links will be actively used on every screen of this learning project. Thus the project has two primary navigational methods, linear presentation of concepts using bulleted lists and nonlinear capabilities for learning using hypertext links selected at will by the student. Some research has advanced nonlinear learning as more effective than linear (Paolucci, 1998). I feel that a combination of linear and nonlinear is called for. Linear presentation is used to provide a thorough exposure to all important concepts and nonlinear navigation is provided allowing the student choice and direction in the learning episode. All of the navigational links will be created with screen design principles in mind, so only a few concepts and links are provided on each instructional screen to promote balance of presentation (Szabo & Kanuka, 1999) and avoidance of cognitive overload.

Student Self Assessment

Student self-assessment of learning is a desired feature of this educational project. Self-assessment practice exercises are included for use after the student completes a learning segment. The process of feedback is

necessary for students to make an independent evaluation regarding the effectiveness of their learning process (Bordeau & Bates, 1996). Bourdeau suggested that meaningful feedback is important to learning. In this project design, an attempt was made to guide the student who responds incorrectly to content questions back to the original presentation of information using hyperlinks. This resulted in an extraordinarily long project with an excessive numbers of hyperlinks. Another undesirable result was that when the project was accessed from the Internet, it was found that download times varied from five to ten minutes, depending upon the Internet Service Provider. I felt this lengthy download time would frustrate students, so I revised the project using fewer hyperlinks and less redirection routes for relearning concepts. A detailed description of this revision can be found in the "Formative and Summative Evaluation" section of this paper.

One last design decision was to select which medium would be used for the creation of this project. Among many considerations for media selection outlined by Bordeau is accessibility of the media (Bordeau & Bates, 1996). Accessibility takes on a special challenge when dealing with a web-based course to students studying in Japan. For

this reason, I decided to select PowerPoint (2000) as the medium for the presentation for many reasons. First of all, PowerPoint (2000) is available at Humanatec Rehabilitation College in Japan because Microsoft Office Suite is available to all students in their campus computer lab. This advantage made PowerPoint (2000) the medium of choice for this project. PowerPoint's user friendliness and its open acceptance of multimedia imports also made it a good choice. Also, I very much enjoyed the attractive presentation templates that PowerPoint (2000) offers, and I felt that the project would have a balanced, attractive presentation, utilizing all desired features of multimedia.

Design Using Visual Cues

The incorporation of visual cues to help students learn medical terms supports dual encoding and is important to the development of this web-based learning. The purpose of visual images is to spur the thinking of the student to prompt recall of words learned in a preliminary reading of assigned chapters in the textbook. It is my intention to have the visual image serve the purpose of an analogy. I enjoy using analogy frequently in instruction, so analogy in a technological instructional

project is a natural outgrowth of my own teaching style. In addition, analogies have strengths for usage in instruction to bridge from students' pre-existing knowledge to target conceptual knowledge (Brown, 1992).

An instructional analogy is defined as a brief comparison between two topics, one that is already known to the student, and the other that is the target information to be learned (Newby, Ertmer, & Stepich, 1995). The analogy serves as a mapping function and bridges to the new information that is to be learned. Many studies have shown that analogies have improved recall in students (Newby, Ertmer, & Stepich, 1995), with particular emphasis upon the mapping process (Rittschof, 1998).

The literature also generously documents limitations of analogy use in effective learning including several studies where no increase in student learning occurs (Newby, Ertmer, & Stepich, 1995). Two factors that may limit effective use of analogy in instruction are lack of understanding on the learner's part as to what the analogy represents and a tendency of analogies to overgeneralize. As feedback is obtained from students on an ongoing basis about which visual image analogies in this project are confusing or not helpful, the images can be adapted and refined to promote recall.

Emphasis on the bridging aspect of an instructional analogy from students' pre-existing knowledge to the truths presented in target knowledge related to improved learning outcomes in students taught with bridging analogies. Bridging analogies are defined as use of students' concrete experiences to serve as an intermediate instructional phase. Research conducted on chemistry high school students who were instructed in a basic physics lessons on force showed that six out of seven students instructed with bridging analogies answered questions correctly, compared to three of seven who were instructed only with text. Additionally, the bridging analogy group related the correct answers to the physics law, whereas none of the text instructed students discussed the physics law supporting the correct answer (Brown, 1992).

Similar findings were noted in another research study conducted by John Clement in 1993 on high school students taking first year physics. His bridging analogy group achieved 27.5% higher accuracy on questions about the same topic of force than students not instructed with bridging analogies (Clement, 1993). Clement's qualitative findings showed that students appeared to easily understand the bridging analogies which caused them to hold fast to the correct physics answers even though they initially did not

believe the concept prior to the analogy. His students admitted that bridging analogies changed their minds about their initial preconceived ideas about physics. And Clement noted that the analogies brought forth considerable discussion among his students (Clement, 1993).

Brown's concluding remarks about his research urged teachers to take care to use analogy examples that are meaningful to students using visualizable and qualitative models (Brown, 1992).

Audio Files

Audio media is another central feature of this instructional project. I feel that providing audio clips of the correct pronunciations of the medical words side by side with visual image cues of the words, and short text descriptions will be a useful instructional strategy. This incorporation of audio files on the Internet is modeled after the traditional use of language laboratories for foreign language instruction. Medical terminology, the language of medicine, is heavily steeped in Greek and Latin roots and lends itself to learning theories that promote foreign language instruction, my opinion. Theorists for some time have maintained that student

participation in foreign language laboratories helps students increase their ability to understand and speak foreign language (Meskill, 1996). So the use of audio clips in this PowerPoint (2000) presentation continues this tradition of language laboratory, but from a different medium of audio files imported to a web-based learning exercise.

Text Presentation of Concepts

The third major component of this web-based design is text presentation of information. It is my objective to use text judiciously with brief presentations of text to supplement the audio and visual components of the lessons. These chunks of text information, presented briefly with other supporting media provide full meaning of the new concepts to be learned (Meskill, 1996).

These three elements, visual image cues, audio files of medical term pronunciations, and chunks of brief text descriptions and definitions of medical terms, comprise the framework of this instructional project. I feel the use of these multiple media is desirable to support good learning outcomes for the students. Some experts feel that multimedia information appears to be more effective for learning in students who have had little exposure to

subject matter being learned (Najjar, 1996). If this is assumption is true, multiple media is ideal for instruction in Medical Terminology as medicine is a subject that is rarely addressed in elementary or secondary education. The student who enrolls in a medical training program will have Medical Terminology as one of their first courses in their program training. The reason is that medical language must be learned before other medical studies can be undertaken. The strong emphasis of multiple media, which some experts feel supports learning for students with low knowledge, provides a sound framework for the design of this project (Najjar, 1996).

An additional assumption of multiple media instruction is that it appears to improve student learning when the media are closely related and support each other. Research has specifically linked improved learning outcomes with combinations of pictures with text (Najjar, 1996). With this finding in mind, the construction of the project will include the incorporation of visual image, audio file, and text information on each screen of the web-based lessons. This structure will highlight the interconnectedness of the media, and hopefully promote student learning.

This multimodal delivery of information is consistent with a current trend in multimedia design (Meskill, 1996). The student's senses will be stimulated from a number of different sources and different learning styles of students will be addressed.

Applying Medical Terminology Content to the Educational Project

The plan for this web-based learning exercise was to create Internet based exercises as an adjunct to presentation of medical terms assigned in the required textbook for the course. The titles for each chapter of the textbook served as a basis for chapter titles of each of the learning exercises in this web-based project to connect Internet learning to textbook learning. The textbook contained thousands of medical words, and actually had more words than were necessary to incorporate into a web-based exercise, so I undertook a review process to select between 20-40 important, challenging, and commonly used medical terms from each chapter. My selection of the words to be used in the exercises was based on my years of experience working in health information departments of large medical centers in Southern California. I wrote a list of these words for

each of the 16 chapters in the medical terminology textbook and the lists were used to build the web-based project.

Since so many words were to be used, I felt it would be useful to promote uniformity in the design of the PowerPoint (2000) slides by creating a template for each of the words. This would assure that each screen designed would be uniformly created, and that no crucial piece of information would be left out. Two categories of templates were created for presentation of the medical words. One template was prepared to present medical terminology concepts. This template was entitled "Pronounce and Translate" and it contained the new word to be learned, an audio file link so that the student would hear the pronunciation made by the author's sound recording, and a visual cue to help prompt to the student's memory about the correct meaning of the word (See Appendix A; Figure 1). The next template was similar in appearance to the "Pronounce and Translate" template and contained the English meaning of the new medical word (See Appendix A; Figure 2). The bottom of each slide contained an escape instruction so that the student could leave the instructional project at any time. Each screen also had a link to the main menu of the lesson, in case the student

wanted to leave that particular segment of the project without completely exiting the program. The animation feature of PowerPoint (2000) was also utilized in these lessons, so that each new medical word presented slowly drifted onto the screen in automatic one second animated intervals. This was done to enable the student to mentally translate the words as they were presented. Nonlinear linkages were also created to allow the student the opportunity to avoid words already known.

The next template was for "Translation Exercises", a self-assessment exercise to help students determine if new words had been completely learned. These exercises consisted of multiple-choice questions about the new words with one correct answer and three confounding answers. Correct response to questions linked to a slide that entitled "Correct" with an audio file of applause. An incorrect response led to an "Incorrect" screen with a screeching brakes audio file, and a link back to the Table of Contents for further study of the missed word (See Appendix A; Figures 4-5).

CHAPTER FOUR

PROCESS OF CONSTRUCTION

First, the identification of the main terms to be learned took place by reviewing the textbook for the Medical Terminology course and lists were created. Then designs of the templates took place for each of the words identified to ensure that each screen design was uniformly created and that no crucial piece of learning information was omitted. This promoted uniform format and consistency among the hundreds of slides that were to be created in PowerPoint (2000). Next, the recording of the sound files took place. A .wav sound file, a digitized recording of sounds, was created for each word that was identified on the lists. I made the recordings on a home computer and the files were saved on a zip disk and eventually imported to he PowerPoint (2000) learning project. The next step was to select images that would be used as analogous visual cues of all new medical words. I subscribed to an Internet clip art source and paid an annual membership fee. I then downloaded as many visual images as I needed in .jpg and .gif format for digitized recordings of images for use in the project. In addition to this, I used a

scanner to obtain nonproprietary images that were useful to the project.

For the translation exercises, a separate identification process took place to identify words that were to be used in the translation process with correct and confounding responses. A creation of a template was also accomplished and then the slides in PowerPoint (2000) were created, a process that required approximately three-four months of part time work.

Evaluation of the Project

According to Weston, McAlpine & Boronaro (1995) evaluation of the educational project requires several steps for the evaluation to be complete. The process should begin with review of the goals of instruction. The goals of instruction should be reviewed to determine if the project meets the objectives of instruction. To complete the formative evaluation, two steps of data collection and data revision are performed (Weston, McAlpine & Boronaro, 1995). Data collection occurs when the educational project is tried out and information about the successes or failures of the tryout process are noted. The second stage of revision occurs when the draft project is modified based on feedback information collected in the

data collection stage. Summative evaluation is the final step in evaluation and consists of a concluding tryout session of the educational project after all data collection and modification has taken place (Dick & Carey, 1996).

In this project, multiple evaluators were used to carry out tryout and data collection. The chief group of evaluators consisted of students enrolled in disease classification courses who had earlier passed a course in medical terminology. Because they were already applying medical terminology knowledge in ongoing studies in the health information management field, their feedback was valued. An additional evaluation took place when a native student from Japan was asked to evaluate the project. She was requested to review the project with regards to its acceptability to the cultural mores of Japan. The evaluation tools consisted of questions with responses using the Likert scale and open-ended questions (See Appendix A; Figures 6-7).

Formative and Summative Evaluation

The health information management students said they enjoyed the online Medical Terminology learning project. They commented that they found it very interesting. They

believed that future students would be interested in using the project as a study tool. The evaluators supported the use of multiple media in this project as a useful study strategy. The overall opinion of the of the evaluators was that the project was a positive learning experience.

The only negative responses had to do with the feedback process of the multiple choice exercises included in each lesson. As originally designed, if a student selected an incorrect answer in the multiple choice questions, the PowerPoint (2000) presentation was simply designed to provide a "Correct Answer" screen if the student chose the correct answer or an "Incorrect" screen for an incorrect answer selection by the student. The "Incorrect" screen originally was designed to link back to the Table of Contents to lead to further review of the missed word part.

The reviewers thought that it would be more efficient if the student selecting an incorrect answer were led directly to the original slide of the missed word rather than to the Table of Contents. This seemed like a reasonable suggestion, so I modified the project to accommodate this navigational change.

After modification, a summative evaluation took place by an entire class of students who used the project in the

summer of 2000. They never really made a thorough evaluation of the project, however, because they failed to use the exercises due to frustration in trying to download the project over the Internet. By linking incorrect answers on the Translation Exercises directly to the original word slides, the size of the PowerPoint (2000) file expanded from approximately 70 slides to 140 slides for an average chapter. Accessing this project from off campus using students' private Internet Service Providers, access time to open the file took anywhere from 5 to 10 minutes, and the students simply lost interest in the evaluation process. Therefore, another modification took place, and the "Incorrect" screen was relinked to the Table of Contents to lead the user back to review of the missed word part. This revision resulted in slightly shorter download times for students accessing the project from home.

The experiences of these evaluators corroborated accessibility findings in the literature. Some experts stated that the speed of downloading a page affects the users' appreciation of hypertext. (Altun, 2000), making it important to open files and obtain the information as rapidly as possible. Diaz also reported that larger

multimedia files often require lengthy download times, sometimes making users wait for too long (Diaz, 1999).

The student from Japan who evaluated the project believed that all aspects of the project including presentation, text, and images were culturally appropriate for native students from the country of Japan.

CHAPTER FIVE

CONCLUSION

My objective in creating this web-based exercise in medical terminology was to provide an adjunct to instruction using textbook and two way interactive television for students taking the course in Japan with the instructor teaching from Loma Linda, California. The project was created based primarily on learning and design theories of constructivism and systematic learning. Constructivism was felt to be advantageous in the study of medical terminology, which begins with basic word parts that build upon each other until fluency is achieved in a complete medical language. Systematic learning was also desired, so that attention to each important word would occur in a directed fashion so as to not overlook any important word that would be regularly used in medical language.

The design and creation of the project was carried out focusing on unity of design and student interactivity. The medium for the exercises was selected to be PowerPoint (2000) due to the fact that it was readily available to the students in Japan in their computer lab on the Yokkaichi campus. The project incorporated multiple media

and text presenting of learning concepts. Audio files were used to support the correct pronunciation of medical terms, and image files were used to provide visual cues to help students learn new medical words.

Health science students who had earlier completed a medical terminology course evaluated the project. Data was collected from their evaluations, and revisions were made to the learning project. The project was retried, and a final series of revisions were made to address feedback and download issues from the Internet. The overall commentary from project evaluators was positive. The evaluators felt that this web-based project was useful and enjoyable.

Now that the Medical Terminology course in Japan has concluded, I look back on the experience and assess the failures as well as the successes. From a teaching standpoint, it was a thrilling experience. There were many technological impediments, some of which could not be overcome. But the overall outcome of the project was successful. All of the students passed the course, and I used the same grading strategy that I use with my Medical Terminology students in the U.S.

One week before I was to arrive in Japan, I emailed the coordinator of the program to be sure everything was

ready. At that time, we learned that the computers in Japan could not log on to Blackboard (Blackboard, 2001) because they were not loaded with English software. The English software was then loaded, and I flew to Japan. I stayed the first night in a business hotel, and as soon as possible successfully logged on to Blackboard from a computer in the hotel. I was very relieved for the successful logon because it was important to me that I show the students how to use Blackboard while I was in Japan. When I arrived at the Humanatec Rehabilitation College campus one day before class was to begin, I was shown the computer lab and I logged on to Blackboard again and determined that the campus was successfully connected to the Internet. Then I learned that our textbooks had not arrived. We ordered the textbooks three months prior to class, but we learned the hard way that the order needed to be placed four months earlier to get to Japan in time. The secretaries helped me prepare photocopies of the essential segments of the textbook for the students. Next, I attempted to place my CD project in Medical Terminology into the computer drive, and learned to my dismay that the CD did not fit. The spindles in the Japanese computers are a different size than U.S. CDs. I tried several more computers, but was not successful. So the months of

preparation that went into the special project of dual encoding for Medical Terminology in Japan could not be used. The next day, I went to the classroom to meet my students. I met with them on Monday, Wednesday, and Friday that week before I returned to the U.S., and spent my time in Japan introducing the course, showing the students how to log on to Blackboard, and engaging the students in many Medical Terminology drills and exercises, emphasizing pronunciation.

I found that the students were well able to understand my English, though they frequently asked me to speak more slowly. But their command of verbal English was very elementary and slow, though by the conclusion of the six weeks study with me through video conferencing, I noticed improvement in many of the students' English skills. They are to further study English in upcoming courses at Humanatec Rehabilitation College.

While I was in Japan, I arranged to have Loma Linda technicians dial us in Japan on the video conferencing equipment. This also proved to be a challenge. On Monday, the dial up did not work. On Wednesday, the Humanatec Rehabilitation College faculty called the company in Japan that sold them the equipment to come on site and examine the equipment. In the process, the phone number that was

given for Loma Linda to dial was changed. On Friday in Japan, we waited for the call again from Loma Linda, and were growing increasingly disappointed as two hours passed with no connection, and then finally, the technician from Loma Linda appeared on the video conferencing screen and spoke to us. In Japan, we were happy and applauded. The reason that the call was late is that we failed to take Daylight Savings time into consideration when arranging the dial up time. There was other time disorientation as well due to the International Dateline. To dial us at 9AM Friday in Japan, the Loma Linda technician needed to connect us on the previous Thursday at 5PM in California.

I have not yet received the student evaluation forms to review, but verbally the students told me they enjoyed the course. The coordinator of the program invited me to return next year. The students learned the material well. I felt the grounding of this project in established learning theory, the planning and evaluation, and the experience derived from previous online deliveries of this course in California helped make this educational venture a successful one.

APPENDIX A:

SCREEN PRINTS

Figure 1 Presentation Template "Pronounce and Translate". The medical term, audio file for correct pronunciation, and visual cue as prompt for mental recall of the medical term are included here.

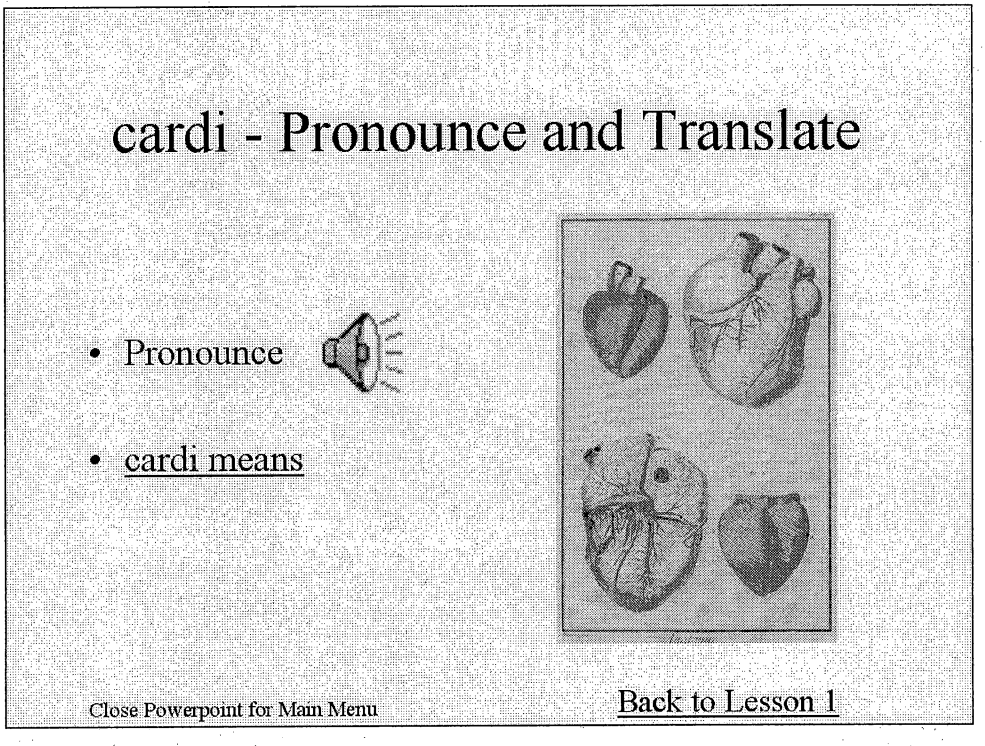


Figure 2 English Meaning Template - "cardi Means". This template provides the English meaning for the medical word to be learned.

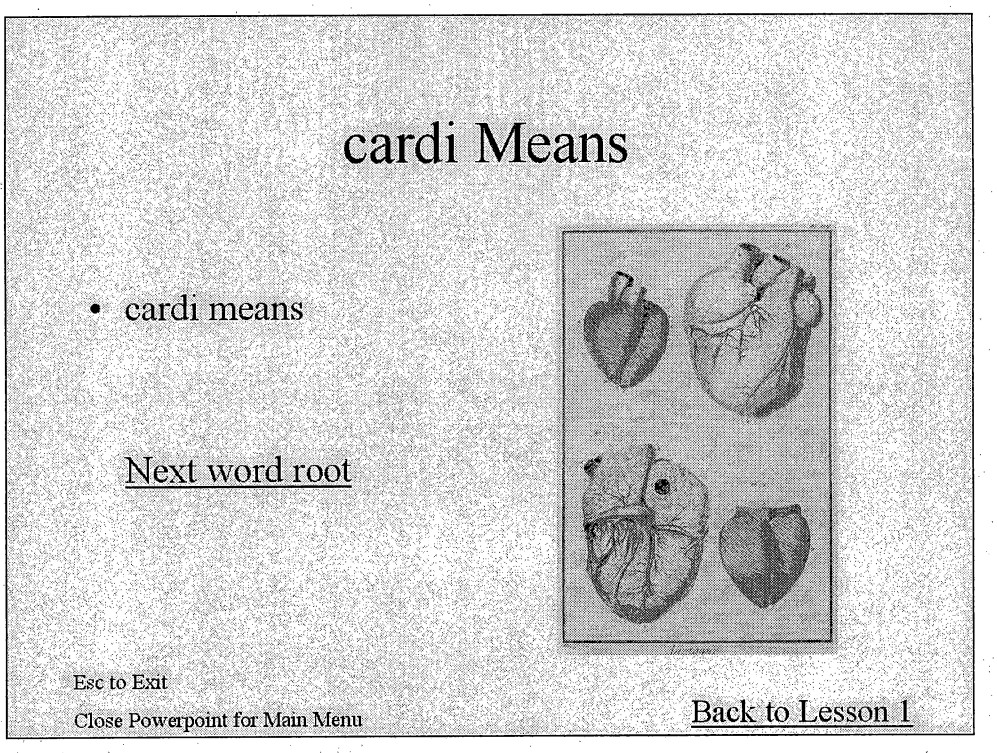


Figure 3 Template for "Translation Exercises". Multiple-choice questions are written for the student to assess if new medical words have been correctly learned.

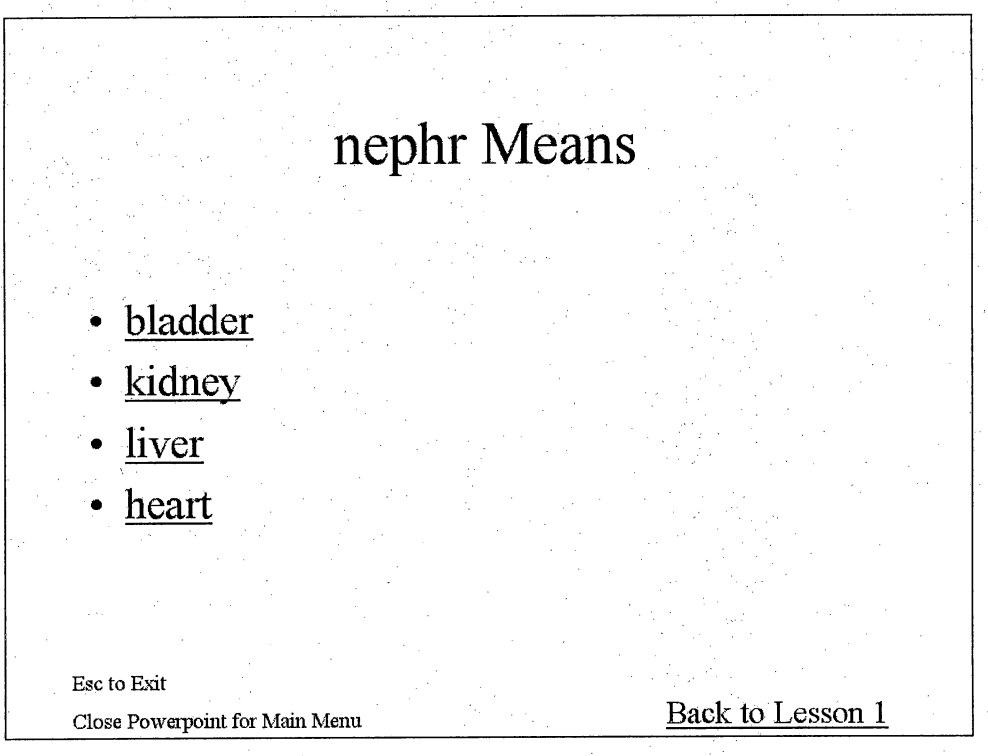


Figure 4 "Correct" Template. Users are linked to this screen when they correctly answer a multiple-choice question about a new medical word.

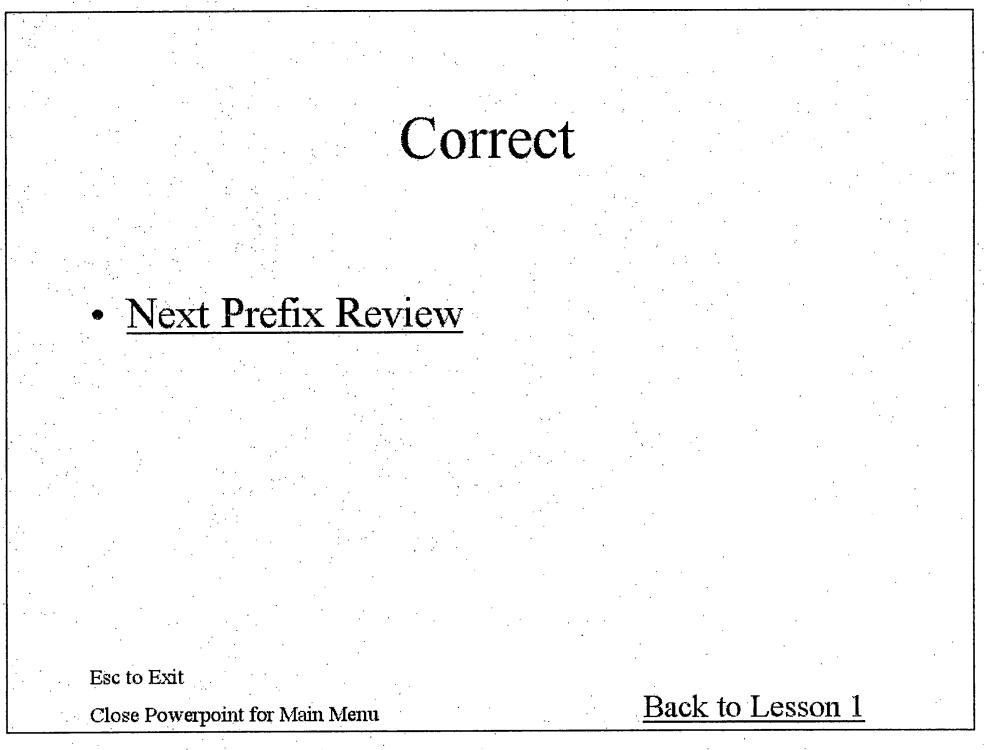
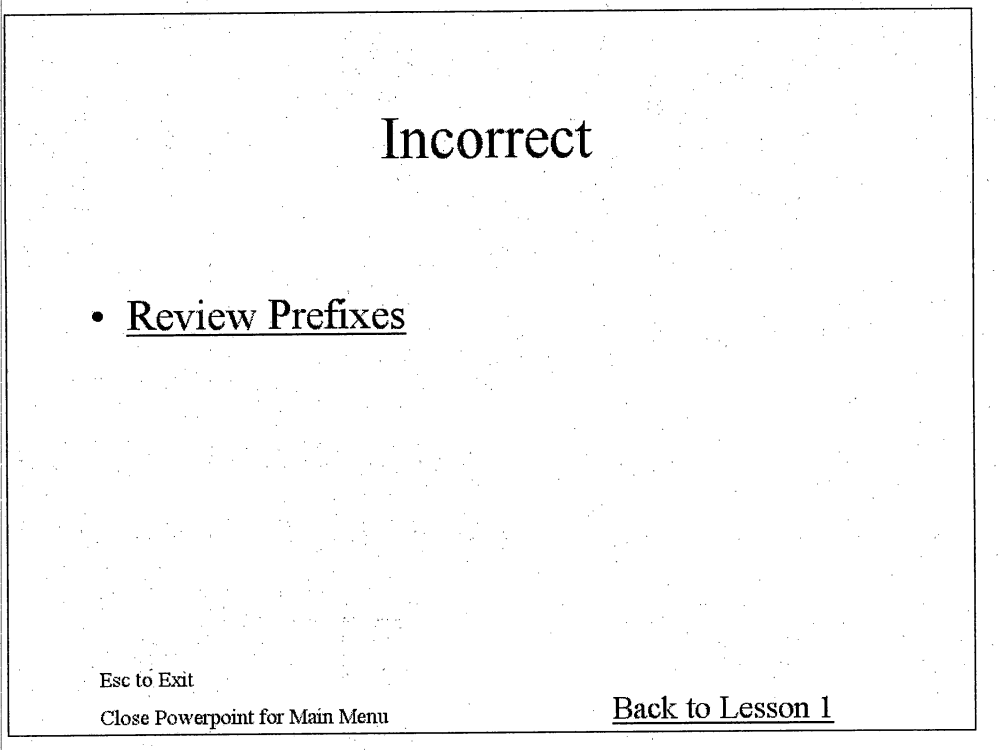


Figure 5 "Incorrect" Template. Users are linked to this screen when they incorrectly answer a multiple-choice question about a new medical word.



APPENDIX B:

STUDENT EVALUATION

Figure 6 Evaluation Rubric - This questionnaire was used by chief evaluators of the project who were students who had earlier passed a medical terminology course.

Rubric

5 – Agree Strongly
4 – Agree
3 – Neutral
2 – Disagree
1– Disagree Strongly

1.	The Medical Terminology lesson was easy to understand.	1	2	3	4	5
2.	The web-based exercises helped me learn new medical terms.	1	2	3	4	5
3.	The lesson was easy to navigate.	1	2	3	4	5
4.	The screens had consistent design.	1	2	3	4	5
5.	Icons were consistent throughout the screens.	1	2	3	4	5
6.	The format of the screens made logical sense.	1	2	3	4	5
7.	The screens had visual cues to help me learn medical terms.	1	2	3	4	5
8.	I was given feedback to help me correct my errors.	1	2	3	4	5
9.	The lesson was flexible, allowing me to selectively study concepts.	1	2	3	4	5
10.	I learned medical terms faster on PowerPoint than from the textbook.	1	2	3	4	5

11. Please list three things you liked best about this lesson.

_____
_____
_____

12. List three things you liked least about this lesson.

_____
_____
_____

APPENDIX C:

JAPANESE CULTURAL EVALUATION

Figure 7 Evaluation Rubric for Native Japanese Student - A native Japanese student evaluated this project for acceptability according to Japanese cultural mores.

Evaluation from a Japanese Cultural Prospective

5 – Agree Strongly
4 – Agree
3 – Neutral
2 – Disagree
1– Disagree Strongly

1. The images on this learning exercise make logical sense to a Japanese student. 1 2 3 4 5

2. The images are culturally appropriate to a Japanese student. 1 2 3 4 5

3. What changes to you recommend for the Images in this lesson?

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