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Implementation and evaluation of interactive online instruction in the dietetic internship

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Implementation and evaluation of interactive online instruction in the dietetic internship

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ABSTRACT

Changes occurring in healthcare, education, and technology instigated the inclusion of interactive online technology in the dietetic internship program. A model of learner-centered, cooperative distance education using interactive online technology is described. Scrollable text, graphics, audio clips, animations, interactive calculators, video clips, and simulations were included in the model. Cooperative learning strategies were incorporated into the online instruction to initiate learner/instructor and learner/learner interaction. Seventy-five dietetic interns from three universities (Iowa State University, Kansas State University, and East Carolina University) served as subjects for the study. Intern classes from each university were randomly assigned to control and experimental groups, with and without online instructional support.

Evaluation of the model included: use of the technology by interns, survey of computer attitudes and learning styles, 'key-feature' exams, and registered dietitian (RD) exam scores. ANOVA and linear regression models were constructed to account for the experimental error introduced by the nested design of the model. Demographic variables and previous computer experience did not influence the use of the online instruction; however, those that reported preferring to work with others tended to use the online instruction more ($p=.05$). Other preferred learning styles did not appear to influence the use of the technology significantly. These findings imply that the technology does facilitate cooperative learning strategies and can be used by a variety of learners. Significant improvement in self-efficacy with the World Wide Web occurred irrespective of the treatment. Interns using the interactive online technology had significant improvement in performance on the nutrition support key feature exam (p=.01) when compared to those not receiving the online instructional support. Intern performance on the pediatric key feature exam was significantly different between the control and experimental groups (p=.03); the experimental group did not exhibit the poorer performance on the post test that the control group did. There was no statistical difference in the two groups' performance on the RD exam.

This study found that interactive online technology can be successfully incorporated into a dietetic internship program. Clinical competency, as evaluated by the key feature exam, was improved with interactive online technology in select settings of the dietetic internship. It appears that interactive online instruction accommodates a variety of learning styles and has the potential to improve competency and technological aptitude.

CHAPTER 1. INTRODUCTION

The 'information age' has precipitated rapid advances in technology. Acquiring the skills to use this technology is critical to position dietetics practitioners to function more effectively in future professional roles. Higher education faces significant challenges as a result of technology, but also changing student demographics and shrinking resources. These challenges are even greater for training health care professionals as the health care revolution changes the resources available for care, and even challenges the definition of desirable care.

It was recently reported that 30-40% of all students at the post-secondary level were pursuing education for a career change (Chambers, et al., 1996). This is true of the Dietetic Internship (DI) at Iowa State University (ISU) where 45% (19 of 42) of the interns over a recent three year span were returning to higher education as an adult learner to obtain a second degree or registration eligibility. Many of these adult learners are prevented from pursuing further education in the traditional campus classroom setting because they are geographically bound. There has been significant growth in distance education nationwide, including the DI at ISU, too meet the needs of these adult learners.

Contemporary students also learn in a style different than that used in higher education. The traditional lecture system focuses on the coverage of material through teaching by telling. This does not fit the preferred learning style for the majority of today's students and a change in the philosophy of programming is necessary (Schroeder, 1993). Learners tend to rely on a particular mode of learning which results in a certain style of learning (Kolb, et al., 1984; Kolb, 1984). Approximately 75% of the general population is estimated to prefer concrete, practical and immediate learning experiences (Wennick, 1999), referred to as sensing learning. Cooperative learning is an instructional strategy that appears to work well with sensing learners. Cooperation and collaboration among students and instructors through teamwork (Johnson et al., 1991) to enhance the learning experience characterizes cooperative learning.

The new millenium has brought with it shrinking resources available to many organizations. This encompasses more than just financial resources, and includes time, personnel, and physical facilities. Business, health care, and public health have experienced significant 'down-sizing' among many facilities and programs. In health care, this has increased the acuity of patients and the complexity of care, altered the scope and environment of practice, and raised the expectations of performance, or competence, in the entry-level practitioner. These trends have limited the number and geographic location of preceptors and facilities available for pre-professional training internships. This has furthered the impetus for using distance education in the DI at ISU.

"Distance education fits into the evolution of education at the millenium" (Connick, 1999) and is encompassing a larger role in the traditional higher education model. There has been an increase in full-time enrollment in distance education over the past 10 years (Wallace, 1996) due to an influx of adult learners (Garrison, 1989). The number of students enrolled in distance education between 1995 and 1998 doubled (754,000 to 1,632,000) and represents 10.5% of the total enrollment in higher education (U.S. Department of Education, National Center for Education Statistics, 1999). Congress reauthorized the Higher Education Act, which identifies distance education as a priority. Advances in communication and information technology have provided the necessary instructional support for the distance education student, which is critical for program and student success. Increasing capability and accessibility of communication and information technology has augmented its use for distance education purposes. Computer ownership has increased 4-5 fold and internet access has grown eight-fold during the past 10-15 years (United States Department of Commerce – National Telecommunications and Information Administration, 1999).

Effective coordination of cooperative learning in a distance education format has created a new instructional paradigm in the DI at ISU. The purpose of this manuscript is to report on the development and evaluation of an interactive distance education model in the DI at ISU which:

- Facilitated growth of the DI with geographically dispersed preceptor sites.
- Provides instructional support with interactive communication technology.
- Includes cooperative learning strategies to improve competency of entry-level dietetics practitioners.

Research Objectives

The objectives addressed by this study were to:

1. Determine if interactive communication technology can improve intern outcomes.
   - Examine intern attitudes toward and comfort with computers and technology.
   - Examine 'key feature' exams to evaluate clinical decision-making and competency.
   - Examine intern performance on the RD exam.
2. Identify intern characteristics that predict intern outcomes.

Dissertation Organization

This dissertation includes an introduction, review of the literature, methods, and three manuscripts. General conclusions follow the manuscripts and references for the first three chapters can be found at the end of the manuscript.

CHAPTER 2. LITERATURE REVIEW

Incorporating state-of-the-art communication and information technology in the DI at ISU has resulted in a new instructional pedagogy. A review of the literature relevant to the development and evaluation of this instructional pedagogy includes: (a) educational theory including the behaviorist theory, Bloom's Taxonomy, cognitive development theory, the skill acquisition model, and distance education theory (b) cooperative learning, (c) trends in distance education, (d) trends in dietetic education, and (e) evaluation of competency.

Studies to determine the impact of teachers' characteristics and styles on student learning and progress have been conducted since the 1890's (Smith, 1997). Yet, little is known about the effectiveness of approaches to clinical teaching in terms of student learning (Tanner & Lindeman, 1987), much less the development of professional competence. Many theories of learning have shaped instructional pedagogy to improve the educational process. All learning theories work, but in some learning situations one theory may work better than another (Bevis, 1988).

Behaviorist Learning Theory

Much of clinical teaching has been based on the Behaviorist Learning Theory (Tyler, 1942). This popular approach of the 1960's and 1970's was to define student learning outcomes as measurable behavioral objectives rather than as discipline content. Instructional practice was then modified to bring the student to a common level of performance (Chambers, et al., 1996). The behaviorist theory assumes that knowledge consists of facts, generalizations, principles, laws, and theories, and that things can virtually always be explained by giving causal, functional, hypothetical, or deductive reasons. Thus, the student learns problem solving and decision-making using a deductive method with a set of rules to examine pieces of information. Typical education tends toward this rote-learning rather than encouraging idea seeking, especially in a climate of mandated tests of minimum competence (Frederiksen, 1984).

Unfortunately, behavioral theory promotes training, not professional development (Bevis, 1988). The behaviorist theory is teacher-centered and according to Diekelman (1988) makes the following assumptions as it pertains to nursing education:

- once students are given information in the classroom, they can then practice and apply it in a clinical area.
- all students should acquire some essential knowledge and skills.
- all students ought to have experience in every clinical specialty area.

Yet, the first assumption does not hold true in many instances. Many students have difficulty bridging factual knowledge and professional practice, particularly when encountering novel situations. Problem solving and decision-making by sets of rules taught by the behaviorist theory does not instill the creative strategies necessary to identify, classify, and solve the problems encountered in a changing environment. Thus, the behaviorist theory does not prepare students to function appropriately in the broader and more challenging circumstances frequently encountered in the clinical setting. Clinical education must move beyond behaviorism to meet the demands of the information age, health care revolution and evolving society.

Bloom's Taxonomy

Bloom et al. (1956) proposed a taxonomy of educational objectives to provide a classification system for the goals of education. A model describing six levels of cognition includes knowledge, comprehension, application, analysis, synthesis, and evaluation (see Table 1). The levels are cumulative, i.e. each level above knowledge includes all those

Table 1. Adapted from Bloom et al. (1956) and Sousa (1995).

Knowledge	Remembering or recalling previously learned material. (define, identify, label, list, locate, match, name, recall, restate)
Comprehension	Understanding the meaning of learned information – ability to make sense of the material. (classify, compare, describe, estimate, explain, summarize)
Application	Using learned information in new situations with minimal direction to solve problems. The application of rules, concepts, methods, and theories to solve problems. (apply, assess, calculate, construct, demonstrate, determine, implement, solve)
Analysis	Breaking learned material into its component parts to understand relationships. (analyze, contrast, deduce, differentiate, distinguish, infer, prioritize, recognize)
Synthesis	Putting the parts together to form a plan that is novel to the learner. Creativity is required to formulate new patterns or structures. (compose, create, design, formulate, integrate, produce, reconstruct)
Evaluation	Judging the value of information. The ability to examine criteria from several categories and select those that are most relevant. (interpret, appraise, assess, evaluate, support, justify, translate)

preceding it. Bevis (1988) outlined a similar learning typology that also contains six categories: item learning, directive learning, rationale learning, contextual learning, syntactical learning and inquiry learning. Bevis believes that the lower categories of learning are found in training/technical programs; whereas, the upper levels of learning occur in baccalaureate and higher degree programs. Thus, to achieve higher level learning and increased competence more emphasis must be placed on teaching that educates rather than trains.

Cognitive Development Theory

The Cognitive Development Theory uses the taxonomy proposed by Bloom et al. (1956) as its foundation. There has been a movement from the Behaviorist Learning Theory to the Cognitive Development Theory in much of education, including clinical education. Future professionals need to be prepared for the challenges of tomorrow which do not conform to sets of rules used in behaviorist theory. Cognitive theory is based on how individuals reason about issues and in particular, how they take diverse viewpoints into consideration during the decision-making process (Valiga, 1988). Cognitive development occurs when a learner is faced with novel situations that cannot be assimilated into an existing structure – the learner alters the structure to adjust to more complexity. The following are characteristics of the cognitive development theory (Valiga, 1988):

- comfort with conceptual complexity;
- tolerance of ambiguity and uncertainty;
- management of diversity and conflicting information;
- decision-making despite incomplete and fallible information;
- clear reasoning;
- concise, informed synthesis of key issues involved in a situation;
- ability to structure and organize knowledge and experience;
- reasoning in an open and critical fashion;
- flexibility;
- consideration of other views while retaining one's own;
- taking on new roles;
- use of criticism for creative achievement.

These characteristics equip the learner with skills to effectively cope, solve problems and make decisions in an increasingly complex healthcare system. In view of the enormous changes in the world's knowledge that can take place in a lifetime, teaching these generalized procedures for problem solving and decision-making in novel situations is a necessity (Simon, 1980).

The cognitive theory of development is more apt to result in competency, the desired outcome of clinical education. Competency, as defined by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO, 1998) is the possession of the knowledge, skills, and behaviors to perform assigned tasks. Competencies are the statements of performance expected of entry-level practitioners (Chambers, 1995b) and refer to the specific knowledge, psychomotor skills, critical thinking abilities and interpersonal attributes required for one to be considered competent (Inman-Felter & Rops, 1998). Although the behaviorist theory develops the knowledge and psychomotor skills of competence, the cognitive theory fosters the development of critical thinking and interpersonal skills. Using the cognitive theory in the development of competency differs from the behaviorist theory in the following manner (Chambers, et al., 1996):

1. The performance context for behavioral objectives is the educational environment as opposed to the practice environment.
2. Behavioral objectives dissect the cognitive, psychomotor, and affective domains and leave them unintegrated.
3. Educational systems based on behavioral objectives overemphasize low-level cognitive accomplishment
4. Behavioral objectives are based on a psychological foundation of behaviorism, which makes it too mechanical and too manipulative.

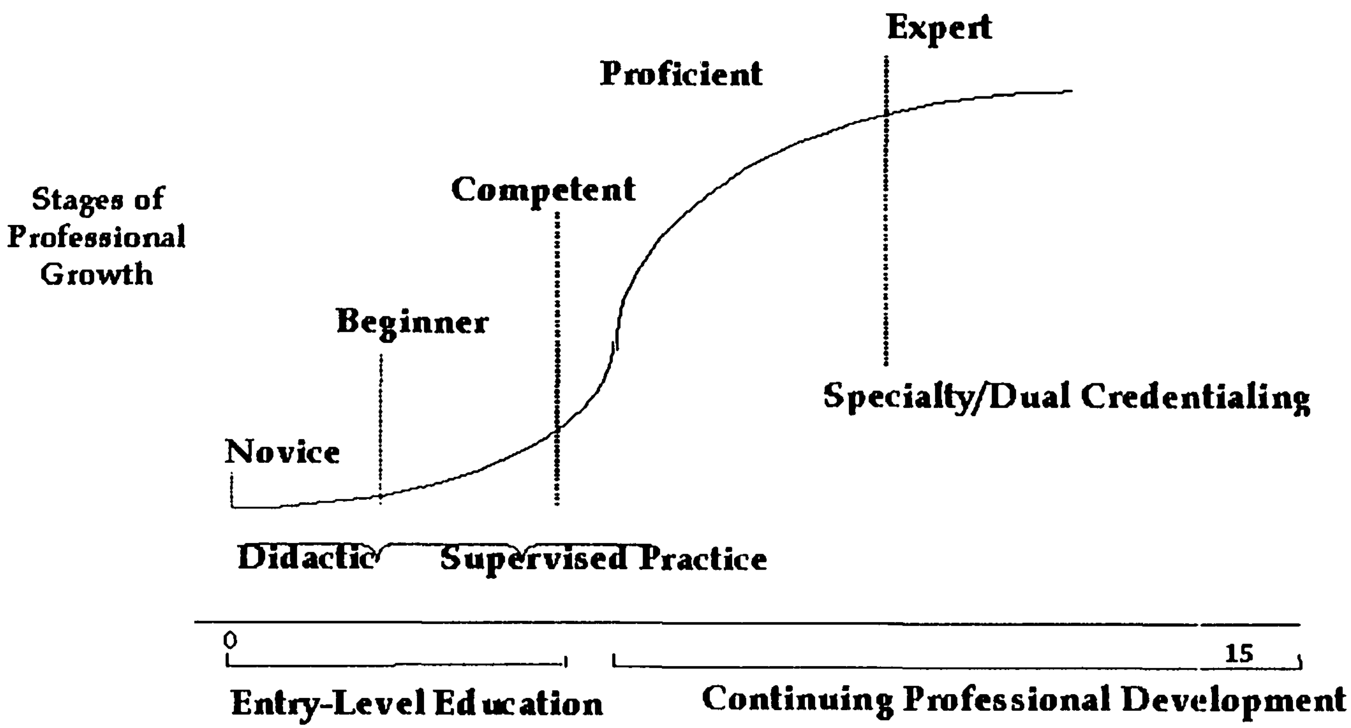
Competence represents the point where a learner has acquired enough understanding, skill, and appropriate values to continue professional development independently (Chambers, 1995a) and marks a transition from formal learning to informal learning (Chambers, et al., 1996). This shift in responsibility for learning from the educator to the learner occurs primarily during supervised practice of clinical education (Chambers,et al., 1996), such as the DI.

Dreyfus and Dreyfus Skill Development Model

There are two different kinds of knowledge (Leinhardt, 1992): concepts and principles (i.e. knowing that) seen in Bloom's taxonomy and the Cognitive Development Theory, and actions and skills (i.e. doing that) seen in the Skill Acquisition Model by Dreyfus and Dreyfus (1986). Competency includes practitioner skill in addition to concept knowledge. Skill acquisition, which commonly occurs in a pre-professional training program such as the DI, is a necessary component of practitioner competence. It is crucial to teach the knowledge of concept and skill together to bridge the knowledge and skill for the learner (Leinhardt, 1992).

A model to describe the process of skill acquisition by Dreyfus and Dreyfus (1986) (see Figure 1) was adapted by the American Dietetic Association (ADA). This model proposes that skill acquisition and competency occurs along a continuum from novice to expert. Five stages of professional growth occur in the acquisition and development of professional expertise. The attempt to recreate human decision-making with computers, or artificial intelligence, served as the basis for the model. From their work, it was determined that human decision-making does not use logical step-by-step information processing, but rather a subjective element, intuition, is acquired with experience and frequently influences decision-making by the expert. The acquisition of knowledge in Bloom's Taxonomy and expertise in the skill acquisition model probably occur synchronously (at the same time or in real time). Combining these models to describe the acquisition of knowledge and skill, more completely addresses the transition to competence and expertise than any theory alone.

COMPETENCY-BASED EDUCATION



Lifelong Learning

Figure 1. Competency-based education. Copyright The American Dietetic Association. Reprinted with permission

The lower three levels of Bloom's Taxonomy (knowledge, comprehension, and application) describe convergent thinking processes where the learner recalls and focuses information to solve a problem through application (Sousa, 1995). A foundation of knowledge is necessary to achieve the higher levels of cognition (analysis, synthesis, and evaluation) and should be taught in an organized manner to facilitate retrieval of information for practice situations (Frederiksen, 1984a). These lower levels of Bloom's Taxonomy interface with the first two stages of the skill acquisition model. The first stage of skill acquisition, novice, has no experience with expected performance and is taught by objective rules and procedures (Benner, 1984). This is analogous to knowledge in Bloom's Taxonomy, the novice learns to recognize various objective facts and features (i.e. weight, input/output, diagnosis, clinical laboratory values) relevant to the skill. The novice learns rules for determining actions based upon these facts and features (Dreyfus, 1982; Dreyfus & Dreyfus, 1986). This corresponds to comprehension in Bloom's Taxonomy. The relevant elements are so clearly and objectively defined for the novice that they are recognized without reference to the overall situation – they are 'context free' (Dreyfus, 1982; Dreyfus & Dreyfus, 1986). The novice uses information processing (Dreyfus, 1982; Dreyfus & Dreyfus, 1986) and this rule governed behavior is limited and inflexible (Benner, 1984).

The second stage of the skill acquisition model, advanced beginner, is analogous to application in Bloom's Taxonomy. The advanced beginner can demonstrate marginally acceptable performance and is able to observe meaningful situational elements or 'aspects of the situation' (Benner, 1984). These situational elements cannot be defined objectively and are learned after considerable experience dealing with real situations (Dreyfus, 1982; Dreyfus & Dreyfus, 1986). Experience is not just a passage of time, but the refinement of preconceived notions and theory through encounters with many actual practical situations (Benner & Wrubel, 1982). The advanced beginner is not solely dependent on the objective attributes or rules, and has developed situational guidelines, but still requires assistance in setting priorities (Benner, 1984).

In the behaviorist model, the practitioner that makes decisions based on set rules and procedures is classified as a novice or advanced beginner. According to Frederiksen (1984a) this is the 'slow phase' in the development of expertise. This slow stage is analogous to the entry-level education phase of the competency-based model (Figure 1) which brings the practitioner to the competent stage. The slow phase requires teaching concept knowledge and generating problem solving procedures. In this model, the practitioner detaches him or herself from ongoing practical activity and relies on the use of learned rules and procedures. Practitioners at this level feel little responsibility for the outcome of their acts (Dreyfus & Dreyfus, 1986). This lack of responsibility is problematic in current society, which demands accountability. The novice and advanced beginner are unable to deal with unique complexities because they lack problem solving skills, they still use rules for decision-making.

The upper three levels of Bloom's Taxonomy (analysis, synthesis, and evaluation) describe divergent thinking where the practitioner's processing results in new insights and discoveries that are not part of the original structure (Sousa, 1995). This describes the higher levels of the Cognitive Development Theory where the practitioner develops skills to analyze a problem, synthesizes and prioritizes the information, to create new structures and solutions. This also corresponds to the last three stages of the skill acquisition model of skill development (competent, proficient, and expert).

Competence is the third stage of the skill acquisition model and is analogous to analysis in Bloom's Taxonomy. Competence, the performance expected of entry-level practitioners, is the desired outcome of academic preparation and pre-professional training programs, such as the DI (Oakland, 1997). The competent practitioner has a goal in mind and sees a situation as a set of facts, which are prioritized, a decision is made and action is carried out (Dreyfus, 1982; Dreyfus & Dreyfus, 1986). Competency is the ability to cope and manage many contingencies realizing there are no steadfast objective rules. In addition, competent practitioners view their decisions and actions in terms of long range consequences, whereas the novice and beginner can only apply the rule to the present situation (Benner, 1984). The competent practitioner deliberately plans, coordinates, and feels responsible for the results of their decisions (Dreyfus & Dreyfus, 1986). Duch (1998) has summarized competency as the ability to:

1. Think critically and analyze and solve complex, real-world problems.
2. Find, evaluate and use appropriate learning resources.
3. Work cooperatively in teams and small groups.
4. Demonstrate effective oral and written communication skills.
5. Use content knowledge and intellectual skills to become continual learners.

In the fourth stage of the skill acquisition model, proficiency, the practitioner perceives situations as a whole rather than pieces of information (Benner, 1984). This stage corresponds to synthesis in Bloom's Taxonomy where the perception of a situation is not thought out, but presents itself from experience (Dreyfus, 1982; Dreyfus & Dreyfus, 1986). The proficient practitioner does not break down the situation into its component features, but has a deep situational understanding that occurs from holistic understanding of complex clinical situations. Holistic understanding improves decision-making, since it is less labored and facilitates honing in on the significant attributes and aspects (Dreyfus, 1982; Dreyfus &

Dreyfus, 1986). This perceptual awareness can only be developed with clinical exposure, because experience is necessary for moving from one level of skill to another (Benner & Wrubel, 1982). There is a significant difference in the level of skilled performance that can be acquired through principles and theory versus those that can be acquired in real situations (Dreyfus, 1982) and formal education theories cannot explain nor reproduce this subjective ability (DeGroot, 1966).

The final stage of skill development according to the skill acquisition model is expertise, which is analogous to evaluation in Bloom's Taxonomy. Here, there is total engagement in skillful performance; the expert is so deeply involved in dealing with the situation that problems are not seen in a detached way and then solved. Benner (1984) has conducted qualitative analysis in nursing education to examine clinical knowledge development. She concludes that experts don't make decisions based on facts and rules, but rather holistic qualitative distinctions. This results in flexible, proficient performance. Where novices follow rules, experts respond to an identified need in the environment and continue to perform (problem solve and make decisions) until that need has been satisfied (Chambers, et al., 1996).

Professional practice knowledge of the expert, unlike theoretical knowledge of the novice, relies on the development of perceptual awareness that singles out relevant from irrelevant information; and grasps situations as a whole, rather than a series of tasks from analysis of isolated pieces of information. The expert formulates hypotheses very early in the process and gathers additional relevant data to confirm or eliminate the hypothesis – this is done repetitively until a hypothesis is confirmed. This ability to formulate an early hypothesis is referred to as a 'rapid grasp of the problem' in the skill acquisition model

(Benner, 1983). This represents the 'fast phase' in the development of expertise where problem solving procedures in the practitioner become automatic and independent (Frederiksen, 1984a). The expert intuitively sees what to do without application of rules (Dreyfus, 1982; Dreyfus & Dreyfus, 1986) and zeros in on the appropriate part of the problem without wasteful consideration of many alternatives (Benner, 1984). This intuition appears to be a legitimate and essential aspect of clinical judgment (Benner & Tanner, 1987).

Dreyfus and Dreyfus (1986) identified aspects of intuitive judgment in the expert:

- pattern recognition – perceptual ability to recognize relationships without pre-specifying the components of the situation.
- similarity recognition – ability to recognize resemblances despite marked differences in objective features of past/present situations.
- commonsense understanding – deep grasp of culture and language so understanding in diverse situations is possible.
- skilled know-how – embodied intelligence.
- sense of salience – differentiating events as more important or less important without rule governed behavior.
- deliberative rationality – clarifying one's current perspective by considering how one's interpretation of a situation would change if one's perspective were changed (trying different alternatives).

Many times, experts cannot put their intuition into words, let alone rules. This 'know how' which is representative of higher cognition and skill cannot be objectively described. This is in contrast to the 'know that' of lower cognition and skill, which conforms to objective facts and rules (Dreyfus, 1982; Dreyfus & Dreyfus, 1986). An expert practitioner develops 'rules of thumb' that are combined with book knowledge (Feigenbaum & McCorduck, 1983). This intuitive ability is desirable since ill-defined problems found in the real world many times cannot be reduced to a set of rules. Formal structural models of decision analysis have not been able to describe this advanced level of expert understanding and clinical performance (Dreyfus, 1982; Benner, 1984).

The skill acquisition model describes a progression from detached analytic performance to involved skilled behavior. The slow, detached reasoning of the problem solving process seen in the first three stages evolves into rapid, fluid, involved behavior (Dreyfus & Dreyfus, 1986). This progression of skill development results in the following changes in the practitioner (Benner, 1984):

- move from reliance on abstract principles to use of concrete experiences.
- situation is seen less as bits and pieces and more as a whole in which certain parts are relevant.
- change from detached observer to involved practitioner.

Table 2 provides an overview of the skill acquisition process and characteristics of the practitioner at each stage of the skill acquisition model (Dreyfus, 1982; Dreyfus & Dreyfus, 1986).

Table 2. Adapted from Dreyfus (1982) and Dreyfus and Dreyfus (1986).

Skill Level	**Component Recognition**	**Salience Recognition**	**Situation Recognition**	**Decision**	**Commitment**
Novice	Context free	None	Analytical	Rational	Detached
Advanced Beginner	Context free and situational	None	Analytical	Rational	Detached
Competent	Context free and situational	Present	Analytical	Rational	Detached understanding & deciding Involved in outcome
Proficient	Context free and situational	Present	Holistic	Rational	Involved understanding Detached deciding
Expert	Context free and situational	Present	Holistic	Intuitive	Involved

Distance Education Theory

Three major themes have emerged in distance education theory (Keegan, 1986). The first theme, autonomy and independence, is founded upon the perceived autonomy and isolation of the students (Delling, 1978). The role of the teacher and educational organization is minimal and a learner-centered structure with minimal input from the institution and instructor is created. Wedemeyer (1981) identified ten characteristics of a desirable distance education system functioning under the theory of autonomy and independence:

1. The system should be capable of operation at any place where there are students – or even only one student – whether or not there are teachers at the same place at the same time.
2. The system should place greater responsibility for learning on the student.
3. The system should free faculty members from custodial type duties so that more time can be given to truly educational tasks.
4. The system should offer students and adults wider choices (more opportunities) in courses, formats, methodologies.
5. The system should mix and combine media and methods so that each subject or unit within a subject is taught in the best way known.
6. The system uses, as appropriate, all the teaching media and methods that have been proven effective.
7. The system should cause redesign and development of courses to fit into an 'articulated media program'.
8. The system should preserve and enhance opportunities for adaptation to individual differences.
9. The system should evaluate student achievement simply, not by raising barriers concerned with the place the student studies, the rate at which he/she studies, the method by which he/she studies of the sequence within which he studies.
10. The system should permit students to start, stop and learn at their own pace.

The second theme, industrialization proposed by Peters (1971), equates the distance teaching/learning process to the industrial production of goods and purports that distance education is the most industrialized form of education. Central to this theme is the function of an institution in developing learner materials. This theme is frequently seen in much of the distance education literature where development of successful distance education programming focuses on the production of materials. However, distance education encompasses two operating systems – distance teaching or course material development and distance learning or student support (Keegan, 1986; Showalter, Armstrong & Veale, 1998). Distance learning students require a range of services beyond instructional materials to be successful. Recognizing and acknowledging these needs is the master key to retention and success in distance education (Connick 2000).

Interaction and communication, the third theme of distance education theory purports that interactions among students, between faculty and students, and the collaboration in learning that results from these interactions are key to the learning experience in distance education (Palloff & Pratt, 1999). Distance education requires more attention to strategies that promote interactions, which stimulate active learning with a purposeful, dynamic environment facilitating peer interactions (Kochery, 1997). These interactions have been identified as a benchmark for successful distance education programming (Institute for Higher Education Policy, 1999). Teaching in a distance education system involves balancing learning activities between those which the student carries out independently, and those activities involving interaction and communication with others. Daniel and Marquis (1979) believe there must be a synthesis between the two types of activities. Baath (1982) believes that two-way communication achieves this synthesis while Holmberg (1983) prefers 'guided didactic conversation'. Holmberg claims this conversation can be 'real' as in correspondence, phone, or personal contact or 'simulation' with text and course materials. Gunawardena (1992) proposes that learner/learner and learner/instructor interaction are key to successful distance education delivery. Fortunately these interactions are supported by current communication technology.

Today, the Internet and World Wide Web (referred to as online technology) have expanded the possibilities for distance educators and offer collaborative technologies that can be used to enhance and expand interaction and communication in distance education (Bull, et al., 1999; Kearsley, 2000). A theory developed specifically in the context of online technology is the 'engagement theory' by Kearsley and Shneiderman (1998). This theory suggests that online learners must be actively engaged for effective learning to occur. Engagement according to Kearsley and Shneiderman includes designing, planning, problem solving, evaluating, decision making, or discussion. In the engagement theory all learning should be collaborative, problem-based, and authentic. Case-based or problem-based learning is commonly used in health care training. This is similar to the engagement theory and is becoming more popular in distance education as online technology supports the delivery of this mode of instruction. These instructional strategies also include critical thinking, another key component to successful distance education according to Gunawardena (1992).

Instructional Theory

Bordage and Lemieux (1991) have examined the relationship between medical knowledge and physician's diagnoses (a marker of competence and performance). This analysis was conducted from 'thinking-aloud' protocols. The protocol involved giving a practitioner a specific clinical situation where they 'think aloud' or verbalize the thought processes involved in making a diagnosis. They found that the determining factor in making the accurate diagnosis was the use of abstract associations that relate the symptoms and signs, and role of the associations. Teaching underlying principles (i.e. signs and symptoms) alone does not improve performance. Formal teaching strategies, such as case studies, simulations, or hands on experimentation, are necessary to help students organize concepts and link knowledge to practice (Bordage & Lemieux, 1991).

To achieve professional competency the different kinds of knowledge, concepts/principles and actions/skills, need to be taught together (Leinhardt, 1992). This helps students connect the specific content knowledge with strategic action. Using real tasks in training, as in the DI, is the preferred method of instruction to link concept knowledge and skill development. This link is critical in the development of higher cognitive skills such as problem solving and decision-making, important to professions such as medicine (Frederiksen, 1984a).

The study of problem solving and decision-making in the medical community is plagued by many difficulties (Fischhoff, 1979). Currently, instruction in problem solving and decision-making generally emphasizes well-defined problems, not the ambiguous problems that are encountered in real life. Ambiguous problems contain a potentially unlimited number of possibly relevant facts (Dreyfus, 1982; Dreyfus & Dreyfus, 1986) and require searching out additional information and ideas (Frederiksen, 1984a). Other educators believe that the data collection process is a key element in clinical decision-making, thus instructional strategies should include both relevant and irrelevant facts to develop this skill (Elstein et al., 1978). For students, the majority of problems are ambiguous because they lack experience. Training and development of problem solving and decision-making skills is achieved through a great deal of training and practice with real situations (Glaser, 1976; Dreyfus, 1982; Dreyfus & Dreyfus, 1986).

A problem solving theory popular in clinical education proposed by Frederiksen (1984a) includes three phases: problem representation, problem-solving procedures, and pattern recognition or 'chunking' of information. Instructional strategies used to teach problem representation include analogies and decision analysis (Corcoran & Tanner, 1979). Analogies can supply a mental image of the problem or promote viewing the problem in another context, while decision analysis may include a decision flow diagram (algorithm) which identifies expected outcomes. Problem representation might include demonstration, examples, models of good responses, and practice with feedback; but not much is really known about what to demonstrate or what should be practiced (Frederiksen, 1984a). Benner (1983) believes the use of case studies and simulations can be used for problem representation to develop the proficient and expertise practitioner in the skill acquisition model. She proposes that these should contain some irrelevant, extraneous material and in some instances, insufficient information to make an intelligent choice, representing an ill-defined problem similar to real clinical situations (Benner, 1984). Frederiksen (1984a) believes the strategies used in problem representation should exist in a variety of formats and settings to maximize transfer; the more realistic the settings, the greater the likelihood of generalization to real-life problems. Incorporating inductive instruction, where the learner supplies his or her ways of understanding, also fosters proficiency and expertise. For example, the learner can present case studies where they felt successful and the intervention made a difference, or where they were not satisfied with their performance (Benner, 1984).

The second element, problem-solving procedure, may be taught by hypothesis testing and 'thinking aloud'. Although most research on problem solving has been based on well-defined problems, Frederiksen (1984a) believes the primary method used in ill-defined problems may involve hypothesis generation and testing. Each hypothesis is tested by gathering additional information (asking questions, consulting external sources, carrying out procedures), evaluated in light of the outcomes, and rejected, modified or retained. The 'thinking aloud' strategy used in medical education (Bordage & Lemieux, 1991), has been used by Kight with dietitians. She adapted this strategy from secondary educators, Ehlinger and Pritchard (1994), as a 'think along' in dietetic practice. This strategy allows students to construct and verbalize their own understanding and knowledge structure, another form of inductive instruction.

The third element, pattern recognition, is taught by repetitive practice and modeling (Frederiksen, 1984a). Pattern recognition skills have been documented in physicians (Norman, et al., 1979) and it appears that with training and experience physicians learn to perceive patterns or 'chunks' of signs and symptoms that correspond to disease entities. This 'chunking' represents a strategy to learn and organize new concepts which Bordage and Lemieux (1991) determined as a necessary component of diagnostic thinking. Kight (1975) refers to these 'chunks' as diagnostic categories and has proposed a classification system of Dietetic-Specific Nutritional Diagnostic Codes (D-S NDCs) (Kight, 1985). Chunking is taught by focusing on the whole situation and providing intensive feedback about the accuracy of clinical judgments – not by teaching elemental parts. This is best accomplished by case studies and performance feedback, not lectures (Benner & Tanner, 1987). Collapsing information into larger units (chunks) is necessary to increase processing speed (Frederiksen, 1984a) and is analogous to automatic processing in information processing theory (Shiffrin & Schneider, 1977). This pattern recognition is characteristic of the proficient and expert performer in the skill acquisition model. Ultimately, the major prescription for teaching pattern recognition, or chunking, seems to be a great deal of practice (Frederiksen, 1984a).

Significant problem solving skills can be developed after much training and practice. This requires appropriate and well-organized foundations of knowledge, adequate representation of the problem, automatic information retrieval and processing, and an efficient pattern-recognition system, which together trigger appropriate problem solving procedures (Frederiksen, 1984a). Yet, learning appears to be situation specific, and many times problem solving strategies are not transferred from one situation to another (Nastasi & Clements, 1991). To teach problem solving for real life scenarios, or ill-defined problems, the discovery method may be more likely to lead to the ability to generalize the acquired procedures to problems which may not closely resemble the problem being taught (Frederiksen, 1984a). Egan and Greeno (1973) compared two methods of instruction, discovery and rule learning, to teach concepts of probability. They found that discovery learning required the students to create their own cognitive structure, while teaching rules resulted in adding to existing structure rather than reorganization of structure.

While knowledge of the cognitive processes involved in problem solving is far from complete, information on instructional methods and their value is even sparser. Yet, developing higher cognitive function, including problem solving and decision-making, is key to professional competence. Teaching problem solving strategies makes the learner less dependent on instruction; hence they are developing ‘learning to learn’ abilities (Resnick, 1976; Glaser, 1976). This fosters skills necessary for the lifelong learning required for competence and expertise (Armstrong & Mahan, 1998).

Cooperative Learning

An instructional pedagogy, cooperative learning, meets many of the challenges encountered in the development of higher cognitive skills and incorporates the distance education themes of interaction and communication and engagement. It also incorporates learner/learner and learner/instructor interaction with critical thinking that Gunawardena (1992) believes is key to successful distance education delivery. This belief stems from her experience with distance teaching at the graduate level in two settings: a course taught at a distance using audiographics conferencing and computer-mediated communication, and an online distance learning experience incorporated into a traditional class. These courses involved cognitive skills at the higher levels of Bloom's taxonomy (analysis, synthesis, and evaluation) which were achieved with discussion, debate and problem solving. Cooperative learning is the result of 25 years of research at the University of Minnesota by brothers, David and Roger Johnson. "Cooperative learning is indicated whenever the learning goals are highly important, mastery and retention is important, the task is complex or conceptual, problem solving is desired, divergent thinking or creativity is desired, quality of performance is expected and higher level reasoning strategies and critical thinking are needed," (Johnson et al., 1991; pp. 2:13-14).

Historically, higher education has been competitive and individualistic, however, competitive and individualistic learning does not create social context and interpersonal interactions necessary for deeper level learning and the modification of relevant attitudes and behaviors (Johnson & Johnson, 1987). Education is in need of reform, and the driving force for reform is the realization that successful employment and citizenship require different knowledge and skills than in the past. Management philosophies in business, industry and education predict that team-based work environments will be needed for success in the future (Cavalier, et al., 1995). Employers need employees who can communicate effectively, work productively with others, and integrate knowledge with problem solving. Companies need involved and committed employees, who are self-directed and creative thinkers, who continuously seek to upgrade their knowledge and skills, rapidly and continuously improve products and services, and are willing to move from job to job. Yet, educators in higher education continue to use a competitive and individualistic structure, and view students as empty receptacles waiting to be filled by knowledge from the instructors (Johnson et al., 1991). These educators must ultimately realize that knowledge and skills are of no use if the student cannot apply them in cooperative interaction with other people (Smith, 1986).

Cooperative learning is a group learning process built on the belief that students learn better when they learn together (Johnson et al., 1991). It is a structured, systematic instructional strategy in which students work together in small groups toward a common goal to maximize their own and each other's learning. Cooperative learning is more effective for individual students than individualistic or competitive strategies for promoting learning and cognitive development (Johnson et al., 1981). Valiga (1988) believes that this cognitive development depends on peer interaction among students and openness of student-faculty relationships. This instructional strategy empowers students to think and learn for themselves, as well as teach specific content and ensure active cognitive processing.

The fundamental elements of cooperative learning include positive interdependence, face-to-face interaction, individual accountability, and social skills (Johnson & Johnson, 1987). Positive interdependence is needed to link each student with the others so one cannot succeed unless the others do. Individual performance is assessed and results are given back to the group and individual to achieve individual accountability. Social skills incorporated into cooperative learning include communication, conflict management, decision-making and group processing. Cooperative learning groups provide a useful means for developing transferable skills: students learn how to seek out information, work collaboratively, define problems, design solutions, write and communicate effectively, and grapple with intellectual agreement (Smith, 1986). Cooperative learning promotes collaboration and teamwork, communication skills, problem solving and critical thinking, each contributes to lifelong learning skills.

Research on cooperative learning

There is a significant amount of empirical evidence validating the use of cooperative learning. Research has encompassed successful use of cooperative learning for students from early elementary through college in a variety of content areas including mathematics, reading, language arts, social studies, and science. A meta-analysis of 122 cooperative learning studies by Johnson et al. (1981) found that cooperative learning promoted higher achievement and productivity than competition and individualistic efforts. This analysis compared the percentile performance (50% being average) of students in competitive, individualistic, and cooperative learning. Students in cooperative learning performed at the 80% while the competitive, individualist students performed at the 50%. These findings held for multiple subject areas and for all age groups including college students (Johnson et al., 1984; Roon, et al. As cited in Slavin et al. 1985; Laughlin, 1978). More recently, Johnson, et al. (1991) report that over 375 studies were conducted in the past 90 years evaluating the achievement gained using competitive, individualistic and cooperative teaching. Meta-analysis of these studies revealed that the average student participating in cooperative learning performed at 2/3 a standard deviation above the average student in the competitive and individualistic setting. A sub-sample of this meta-analysis including college and adult studies reported essentially the same. Slavin (1990) reviewed 60 studies investigating the achievement of elementary and secondary students using various cooperative learning strategies. Some of the studies compared more than one strategy resulting in a review of 68 cooperative learning strategies; 49 or 72% of the strategies in this analysis demonstrated a positive effect on achievement.

Active cognitive processing (such as informing, directing, and questioning) accounted for the gains in achievement. Yager et al. (1985) reported that 2^{nd} grade students using structured oral discussion, including explaining, summarizing, and elaborating, in a cooperative learning setting exhibited more achievement and retention than those not participating in oral discussion. Johnson et al. (1985a) identified 5 categories of oral interaction within cooperative learning groups of forty-eight 4^{th} graders. The types of oral statements related positively to achievement included: repeating information being studied; adding new information; contributing information; elaborating on material; and disagreeing with conclusions of another group member. It was also found that speaking was much more important for achievement than listening to collaborators speak.

Higher cognitive functioning is facilitated by cooperative learning strategies. Retention and higher level reasoning strategies have been documented with oral rehearsal strategies used in a cooperative learning setting (Johnson et al.,1980; Skon, et al., 1981; Laughlin, 1973). Johnson et al. (1980) studied the effects of cooperative, competitive and individualistic learning conditions on the problem-solving performance of forty-five 1^{st} graders. Students in the cooperative learning setting achieved higher and used higher quality strategies to solve problems. Skon et al. (1981) investigated the effects of cooperative, competitive, and individualistic goal structures on achievement and acquisition of high-level cognitive reasoning strategies. In this study of eighty-six 1^{st} graders it was found that cooperative peer interaction promoted higher achievement than competitive and individualistic structures. Cooperative peer interaction also generated higher quality cognitive reasoning strategies. Laughlin (1973), in his work with college students, reported that the discussion process in cooperative learning structures enabled members to evolve and use more effective cognitive learning strategies for learning and problem solving.

The social feedback in cooperative learning may enhance a student's sense of competency and motivation towards mastery of knowledge and skill (Nastasi & Clements, 1991). Johnson et al. (1985b) measured the social support in a group of eighth grade Midwestern students using cooperative learning strategies over a period of 3 months. They reported that in classrooms where cooperative learning was used half of the time or more the students were more intrinsically motivated. Leinhardt (1992) believes that the social nature of cooperative learning strategies increases student competency in using terminology, builds on existing knowledge with new knowledge, and creates a linkage between factual and usable knowledge.

Gabbert et al. (1986) investigated the effects of cooperative and individualistic learning techniques on achievement with various tasks designed to represent different levels on Bloom's taxonomy of cognitive educational objectives. Fifty-two first grade students were randomly assigned to cooperative and individualistic learning situations. The higher achievement seen in the cooperative situation transferred to the individual in each of the higher level (ranging from level 4 to 6 on Bloom's taxonomy) reasoning tasks. The students from the cooperative situation also used higher level reasoning strategies. In their meta-analysis of research on cooperative learning, Johnson et al. (1981) also reported higher achievement in higher cognitive tasks such as concept attainment and problem solving. Their findings led them to state, "that one of the most promising mediating variables in this achievement was the cognitive rehearsal resulting from oral discussion of the material.

Problem-solving strategy is an example of indirect instruction, which teaches higher level cognitive processes and is based on the theory proposed by Frederiksen (1984a) the discovery method of meaning. Cooperative learning strategies that utilize a problem solving or investigative focus are more successful in developing higher-level cognitive skills (Nastasi & Clements, 1991). The efficacy of using problem solving in cooperative leraning to increase problem-solving skills was demonstrated by Johnson et al. (1985c) in a study of 4th, 5th, and 6th graders (n=112). Nastasi et al. (1990) incorporated a cooperative problem- solving environment with computer instruction. Improvement in 'executive-level problem-solving processes' was found in this study of 4th and 6th graders. These results also suggested that it is the successful resolution, more than the occurrence, of the problem that accounted for the improvement in problem solving ability. Positive student motivation and learning was documented with computer aided instruction using cooperative learning (Beckwith, 1993; Dalton et al., 1989; Johnson et al., 1985). The ability to use computers to create the cooperative problem-solving environment is important for distance education where computers are frequently used.

Treisman (1985) reported a greater retention rate among black math and science students involved in cooperative learning. This is important in distance education programs where attrition is problematic. Kochery (1997) formulated an information matrix regarding the training issues concerning distance education through a review of the literature and interviews with content experts. From this matrix it was determined the cooperative learning was the most direct means for increasing student involvement, participation, and interaction in the distance education environment.

At the health education level, Frierson (1986) reported increased achievement on state nursing exams for student participating in learning teams. The similarities between state nursing exams and the registration examination for dietitians makes it noteworthy. Performance gains in the workplace have also been documented by Cavalier, et al., (1995) when cooperative learning was incorporated into a required training course.

The ultimate result of cooperative learning is creative problem solving. Thestudents activate prior knowledge and cognitive structures, which they modify or create new structures in novel situations (Johnson, et al., 1991). Students learn less from listening or watching, than from active engagement such as simulations, hands on experimentation and case studies (Johnson, et al., 1985a) which promote more holistic teaching and learning. Active learning calls for abstractness, openness, flexibility and readiness for independent thinking and action (Middlemiss & Van Neste-Kenny, 1994).

In contrast to behaviorist-based instruction, which includes only the essential aspects of performance (Gurvis & Grey, 1995), cooperative learning strategies provide opportunity for students to construct and organize their own knowledge and skills, thus students are 'learning to learn'. Student participation, teacher encouragement and student to student interaction seen in cooperative learning are positively related to critical thinking (McKeachie, 1988). The development of higher cognitive skills relies heavily on the student-teacher relationship (Middlemiss & Van Neste-Kenny, 1994), which nurture with cooperative learning strategies. In summary, cooperative learning activities facilitate the learning of course content, improve students' abilities to communicate and work together, engage and interest them in the learning process, and adopt lifelong learning attitudes (Carter, et al., 1997).

Cooperative learning and student learning styles

Cooperative learning is also a better fit for the preferred learning style of contemporary students. Schroeder (1993) collected information on approximately 4000 college freshman whom were administered the Myers Briggs Type Indicator (MBTI). Approximately 60% of these students were identified as the sensing learning pattern (Schroeder, 1993) characterized by a preference for concrete, practical, and immediate learning experiences such as active experimentation, case studies, simulations, and hands on experience. Schroeder proposes that approximately 75% of the general population prefers the sensing learning pattern. Recently, Hagan and Taylor (1999) reported administering the Myers Briggs Type Indicator (MBTI) in a sample of 84 dietetic interns. Results indicated that over half (53%) were the sensing/judging (SJ) temperament. Sensors want to know 'what is' and rely on their senses to find out what they need to know. Judgers tend to live planned and organized lives, they quickly come to decisions so they can move on to their next endeavor. The sensing learner is analogous to the accommodator according to the Experiential Learning Theory (Kolb, 1984). The accommodator prefers doing things, carrying out plans and tasks, and involving themselves in new experiences using concrete experience and active experimentation (Stutsky & Laschinger, 1995). These learners prefer a practice-to-theory approach which actively engages them in the subject matter (Schroeder, 1993).

Students with different learning styles also prefer different learning environments (Kolb, 1984). Learning environments that conflict with an individual's preferred style of learning may be rejected and/or resisted by the learner (Kolb, 1984). Kolb (1984) contends that individuals within human service professions, such as dietetics, have concrete learning styles and prefer an affective learning environment. In an affective learning environment, the learner experiences what it is actually like to be a professional in the field. In contrast, students who score high in active experimentation prefer a behaviorally oriented learning environment. In the behavioral learning environment, the learner actively applies knowledge or skills to a simulation of a practical 'real-life' problem that the learner could expect to face as a professional. In the DI both work setting and simulations are used. This creates a behavioral-affective environment and works well for the sensing and accommodating learners.

The educator using cooperative learning strategies in the behavioral-affective environment acts as the 'guide on the side' or a facilitator of the student's learning and assists the students in learning how to learn. The educator's role is to design ways to engage the student in the mental processes of analysis until pattern recognition or 'chunking' occurs which provides a model for practice (Bevis & Watson, 1989). A variety of teaching strategies should be used by the educator to accommodate different styles of learning, such as linguistic (reading), auditory (listening), visual (seeing), logical (problem solving), or kinesthetic (doing). Varied learning experiences which are learner focused, self-directed, and experiential create and maintain a high level of student interest. The frequent and immediate feedback in cooperative learning increases a student's motivation to learn (Mackworth, 1980). Students develop a sense of competence through student-student interaction and instructor feedback (Nastasi & Clements, 1991).

Perhaps cooperative learning is an example of andragogy rather than pedagogy. In pedagogy, the teacher takes full responsibility for learning of students, but in andragogy the adult student plans his own learning experiences (Knowles, 1985). Knowles (1984) described a paradigm for adult learners, andragogy, which was significantly different from the prevailing theory at that time of teaching children, pedagogy. Cooperative learning is closely linked with the theoretical basis of andragogy. Psychologically, an adult learner prefers to take responsibility for his own life and tends to see himself as 'capable of self direction' and wants others to see him that way. Adult learners returning to the learning environment after a number of years, have life experiences to incorporate into the learning framework and cooperative learning acknowledges this prior learning and experience.

Cooperative learning for the nutrition educator

Johnson and Johnson have formulated direct applications of cooperative learning in nutrition education (Johnson & Johnson, 1985; Johnson & Johnson, 1987). They define the process of nutrition education as 'the teaching of validated, correct nutrition knowledge to the public, which promotes the development and maintenance of positive attitudes toward, and actual behavioral habits of eating nutritious foods, contributing to the maintenance of personal health, well-being, and productivity'. Future nutrition educators whose responsibility is to facilitate behavior change require cooperative learning strategies to develop the appropriate skills which result in long term modifications of attitudes and behavior (Johnson & Johnson, 1987). Unfortunately competitive and individualistic learning does not allow students to experience social context and interpersonal interactions. This may hamper them as professionals when counseling clients to change attitudes and behaviors for better health and well-being (Johnson & Johnson, 1985).

Impetus for cooperative learning in higher education

Numerous reports and recommendations over the past 20 years support the use of cooperative learning in higher education. A report by the Study Group on the Conditions of Excellence in American Higher Education (1984) identified the need to improve student knowledge, abilities, and attitudes, which they proposed could be achieved by increasing student involvement in the learning process. Sakalys and Watson (1985) reviewed studies in nursing education and recommended increasing active learning and student-faculty interaction in the learning environment. In addition, Chickering and Gamson (1987) have identified seven principles for good education:

1. encourage student-faculty contact
2. encourage cooperation among students
3. encourage active learning
4. give prompt feedback
5. emphasize active learning
6. communicate high expectations
7. respect diverse talents and ways of learning

Cooperative learning meets the challenge of all these recommendations and helps future professionals prepare for tomorrow's challenges. Yet, regardless of the learning theory and strategy used, the desired outcome is a andragogy which is participatory, research and values oriented, critical, multicultural, student-centered, experimental and interdisciplinary (Shor, 1986). Empowerment is the desired outcome for the student – the power of inquiry, self-knowledge, and ability to create one's own knowledge structure.

Trends in Distance Education

Distance education began over 100 years ago in the form of correspondence courses. In the 1970s resurgence of interest in distance education occurred due to new communication technology and the industrial economy was replaced by a service and information economy.

At this time a demographic shift also occurred as the number of 18 year olds decreased and higher education began to cater to adults (Connick, 1999). In the late 1980s and early 1990s the economy rapidly became information based and technology intensive (Connick, 1999a). According to Keegan (1986) there are five components, which define distance education:

- The quasi-permanent physical separation of teacher and learner throughout the length of the learning process.
- The influence of an educational organization both in the planning and preparation of learning materials and in the provision of student support services.
- The use of technical media; print, audio, video or computer, to unite teacher and learner and carry the content of the course.
- The provision of two-way communication so that the student may benefit from or even initiate dialogue.
- The quasi-permanent absence of the learning group throughout the length of the learning process so that people are usually taught as individuals and not in groups, with the possibility of occasional meetings for both didactic and socialization purposes.

Online technology has contributed to a significant growth in distance education over the past 10 years. Worldwide there are more than 17,000 courses available entirely online and it is estimated that the online learning market will grow to $8.3 billion by 2002 (Schoefield, 1999). Approximately 2.2 million (15%) of all post-secondary students will be enrolled in online courses by 2002 in the United States alone compared with 5% in 1998 (Schoefield, 1999). The percentage of institutions offering online courses using asynchronous (not in real time) technology increased from 22% to 60% between 1995 and 1998; during this same time the number of distance education courses, degrees and certificate programs nearly doubled (U.S. Department of Education, National Center for Education Statistics, 1999). The majority of online coursework tends to be undergraduate level offerings rather than graduate or professional training; however, the most prevalent certificate programs offered are in health professions are (U.S. Department of Education, National Center for Education Statistics, 1999).

Isolated distance education students can be brought into a community of communicating peers through the use of online e-mail, bulletin boards, chat rooms, and shared workspaces (Goldberg, 1997; Ridenour, 1998). These collaborative technologies can also support cooperative learning strategies by incorporating positive interdependence and individual accountability in the group structure. One of the most significant ways of involving students is to establish minimal levels of participation which require the students to make use of the communication tools available (WebCT, 2000). Various cooperative learning strategies are supported by online technology and can be used to actively engage learner. For example, with groupware software which supports chat rooms, it is possible for the isntructor to develop the 'jigsaw' technique with learning teams in each chat room. Groupware software focuses on problem solving and decision-making tasks that are applicable to professional education (Kearsley, 2000). The bulletin board feature for posting can be used to facilitate asynchronous group learning such as peer review; students may post work on the bulletin board, which is reviewed and edited by fellow classmates. Ruberg et al. (1996) found that a peer review activity in an online freshman writing class and a plant science lab produced a high level of student participation. The American Distance Education Consortium's (ADEC, 1999) guiding principles for successful distance teaching and education, are met using cooperative learning strategies. ADEC believes that 'learning experiences should support interaction and the development of communities of interest' and that multiple interactions, group collaboration and cooperative learning provide increased levels of learning outcomes.

Interactive, graphical computer simulations which allow students to explore concepts for repeated experimentation and practice (Goldberg, 1997) is supported by current technology. Students who actively engage in learning experiences tend to learn and retain more over time; thus, online instruction which requires students to interact with information because the instructor isn't present may result in a greater depth of learning and retention (Hanson et al., 1998). The use of multimedia (combined use of several media at once, i.e. audio, video, graphics, animations) supported by online technology meets another guiding principle identified by ADEC (1999), 'the learner is actively engaged'. ADEC promotes active, hands-on, concrete experiences, learning by doing, and analogy as important pedagogical forms. These interactive, knowledge building approaches (Conway, et al., 1991) and mastery learning (Bahrick, 1984) are approaches strongly recommended in learning/motivation theory and research because performance improves with practice. The interaction of students with the diverse and distributed knowledge made available with online technology breaks down some of the traditional barriers (Bothun & Kevan, 1996).

Historically, computer-assisted instruction or computer-based instruction provided individualized learning experiences based upon behaviorist learning theory (Kearsley, 2000). However, current technology supports simulations to develop problem-based learning and higher order thinking skills such as analysis, synthesis, and evaluation (Dreyfus & Dreyfus, 1986; Goldberg, 1997). Problem-based learning is very compatible with online education because access to resources and expertise is a key aspect of problem solving (Kearsley, 2000). With online technology the learner can manipulate and review materials and pursue additional information which is immediately available and applicable (McCaughan, 1998).

This meets another of ADEC's principles, 'learning environments must include problem-based as well as knowledge-based learning'.

Although simulations can bring the student to the competent level of practice using analytic knowledge, expertise cannot be achieved because they are presented with a well-defined problem. The computer cannot be used to replicate expertise – intuitive decisions of expert practice are not based on analytical rationalization and are constantly changing (Dreyfus & Dreyfus, 1986). Intuitive judgement is what distinguishes expert human judgment from the decisions or computations that might be made by a beginner or machine such as a computer (Benner & Tanner, 1987). Computers can perform at the competent but not the expert level. The computer is best used as a tool and not a tutor; it can be a drill sergeant and works well for training where the learner is learning to negotiate a structured domain such as diagnosing and treating simple problems in the lower levels of cognitive development (Dreyfus & Dreyfus, 1986). Teaching proficiency and expertise of a profession is more than domain specific facts and rules, thus computers cannot be the sole source of instruction (Kilian, 1997).

Another guiding principle identified by ADEC (1999), 'the learning environment makes appropriate use of a variety of media' acknowledges that different learning styles are also encountered in distance education. New online technologies facilitate the transmission of knowledge to cultivate a variety of abilities in students (American Association of University Professors, 1999) using media such as audio, video, graphics, and animations to achieve desired learning outcomes (Kearsley, 2000; Armstrong & Mahan, 1998). Online technologies also support administrative teacher tasks such as assigning, guiding, and evaluating student work.

A negative factor regarding the use of interactive simulations in online instruction is cost. Independent activities (correspondence materials, online text) of distance education are quite economical, but interactive activities (animations, simulations) add considerably to the cost of a distance education system (Daniel & Snowden, 1980; Kearsley, 2000, Showalter et al., 1998; Ridenour, 1998; Hanson et al., 1998). However, interactive activities have been advocated in learning/motivation theory and research to improve student learning (Conway et al., 1991; National Science Foundation, 1996). Kochery (1997) found that his information matrix concurred with the literature, such as Ruberg et al. (1996), and there is a need for maximizing interactions in a distance education environment. In addition, teacher-student interaction and the preparation and teaching of distance-education classes often require significantly more time than that needed for courses offered in traditional classroom settings (Bothun & Kevan, 1996; American Association of University Professors, 1999; Kearsley, 2000; Gunawardena, 1992). Schoefield (1999) suggests that online courses should feature a small student-teacher ratio of no more than 15:1.

Effectiveness of online instruction

Hiltz (1994) conducted a comprehensive review of 22 online courses with 414 enrolled students. She evaluated pre- and posttest questionnaires completed by students, comparison of test scores or course grades, direct observation of online activities, interview with students, and faculty reports in undergraduate courses in sociology, English composition, management, computer science and statistics. From this review, Hiltz (1994) concluded that online instruction was appropriate for well- prepared and motivated students that had adequate access to the necessary technology. The findings included:

- Mastery of course material was equal or superior to that of conventional classes.
- Improved access to professors and educational experiences.
- Increased student participation in courses.
- Higher satisfaction with courses reported by students.
- Improved student ability to synthesize information and deal with complex issues/ideas.
- Increased level of interest in the subject matter of courses.

Kearsley (2000) believes that the learner must be motivated and possess initiative and self-discipline. Online education is very learner-centered with significant autonomy, thus the learners that perform best in this type of learning environment possess basic study skills such as time management, goal setting, and self-evaluation. Additional skills that are needed, however, include effective use of software, conducting online searches and effective use of communication tools. Hiltz (1994) also felt that success of online instruction was dependent on the instructor's ability to build and sustain a cooperative, collaborative learning group. A significant increase in students' grades has also been reported in an online learning experience (Geiss, 1999). In this study optional, internet delivered learning activities were offered for a large introductory microeconomics course (n=1100). Twelve percent of the students participated in all the activities, 7% participated in none, and the remaining participated in one or more of the activities. Active participation in the online learning experiences was associated with a significant increase in the student's grade after holding other influences on the grade fixed.

In a study at this university, Ingebritsen and Flickinger (1998) evaluated an introductory physiology course, one section traditionally taught on-campus (n=134) and another online section (n=81). They found that student retention rates, final grades, and attitudes towards science were similar between those students taught on campus and online. One advantage of the online instruction was that the students covered all the lecture material, whereas on-campus students skipped 18-24% of the lectures. Shih (1998) assessed the learning style of 99 college students in the same online physiology course with the Group Embedded Figures Test (GEFT; Consulting Psychologists Press Inc., Palo Alto, CA), which classified the students as either field-dependent or field-independent. It was found that the learning style of the student did not influence achievement in the online instruction.

Goldberg (1997) examined student academic performance and acceptance of a third-year computer science course, delivered in three modes: online only, online and lecture, and lecture only. Sixty-four of the sixty-eight students in the course agreed to participate in the study and were randomly assigned to one of the three groups. Those in the combination course (online and lecture) performed better than the other two groups (online or lecture only). He also found that students responded positively to the interactive exercises, bulletin board, targets (practice questions on each page) and quizzes (Goldberg, 1997). The negative aspect of the online instruction reported by the students, was their own lack of motivation to keep up on their own; they were more satisfied when the course pace was forced upon them. This supports the conclusion by Hiltz (1994) that success somewhat depends on the motivation of the student.

Physics and astronomy courses at the University of Oregon have been offered in an online format for a number of years. Student evaluations revealed that 80-85% had positive feelings towards the networked instruction. Improved student engagement (amount of time spent with the material) and improved mean exam scores (about 20%) were found (Bothun & Kevan, 1996). In addition, attendance at optional on-campus lectures increased in introductory courses, but decreased in advanced courses. This indicates that students may need less face-to-face contact as they become more familiar with subject matter and/or online skills (Kearsley, 2000). Similar outcomes have been reported in nursing education (Cragg, 1994; Landis & Wainwright, 1996).

An outcome of The Technology and Education Reform project which was funded by the Office of Educational Research and Improvement (Means & Olson, 1995) was that technology increases the attention and study skills of students, improves their capability to assess their own and abilities of others, improves self-esteem and motivation and encourages creativity. Overall, it appears that students generally do as well in online courses as traditional courses, but consistently are more engaged with online courses.

Learning will take place if the method and technologies used are appropriate and interactions between and among students and faculty is promoted (Moore et al., 1990; Verduin & Clark, 1991). An important role of the instructor in online courses is to ensure a high degree of interactivity and participation (Kearsley, 2000). Interactivity can be accomplished with simulations, while participation can be accomplished with the various communication tools discussed previously. The primary role of the instructor in online education is similar to that seen in cooperative learning, that of a coach or moderator rather than a presenter. Because the learner is engaged in active learning, there is less need for extrinsic motivation from the instructor (Kearsley, 2000).

Trends in Dietetic Education

Dietetic educators are challenged to keep pace with contemporary and projected trends in health care in the preparation of future professionals. Payment systems based on diagnosis related groups (DRGs) have resulted in a hospital population of increased severity and multiple health care concerns with decreased length of stay and number of patients. Thus training must instill higher level thinking and use of non-traditional settings such as community-based health care. Dietetic graduates must be equipped with knowledge and problem-solving skills that are high quality and essential to the changing environment (Forker, 1996). Tanner (1990) speculates that much of clinical training in nursing, based upon the behaviorist theory, limits the attainment of quality of clinical education. Thus, clinical educators must explore innovative ways of training and preparing students for future roles and responsibilities (Gates & Sandoval, 1998). This survey of accredited and approved dietetics education programs in the United States (n=276) found that 20% offer multi-skilling courses to prepare dietetics students for future roles. This is important as change in healthcare reduces available resources and staff.

The ADA (1996) drafted competencies to address the changing roles of the dietitian and make new graduates prepared for a competitive marketplace. The competencies are broad, functional statements of the skills, supporting knowledge, and professional values necessary to begin independent professional practice (Chambers & Eng, 1994). An assumption is that supervised practice competencies can be achieved through real life or simulated experiences.

Changes in healthcare and the competencies developed by ADA have created a unique challenge for dietetic training programs. Puckett (1997) recently reported from an informal interview with dietetic practitioners, students, educators, administrators and leaders (N=33) in foodservice industry, that dietetic course work did not prepare practitioners to meet today's challenges because of outdated materials and technology. It was recommended that educators seek methods for gaining practical experience that enhance the formal education process. This is consistent with a report by (Gilmore et al., 1997) which found that dietetic educators tended to underestimate the need for on-the-job training, or experiential learning. Gilmore et al's (1997) report was based on a survey of 149 registered dietitians having less than three years of experience. The survey included 102 draft competency statements in which respondents were asked to: 1. Choose the verb that best described the level of performance they were prepared for during their education, 2. Choose the verb that best described the expected to perform during the first year of employment, and 3. Rank the importance of the competency during the first year of employment. From this survey 15% of the entry-level dietitians reported learning required tasks on the job. It was also found that the educators were consistently more positive than the students in the level of dietetics education achieved. Thus, it appears that experiential learning in dietetic training needs to be increased.

Clinical teaching enables the learner to integrate knowledge and skills associated with caring for patients. This experiential learning occurs during internships and supervised clinical experiences where beginners become competent largely through learning how to apply textbook knowledge and demonstrated laboratory skills (Gilmore et al., 1997). Gates et al. (1990) demonstrated that clinical reasoning skills, which are indicative of competency, are developed during the supervised practice. The gap between the conceptual and the concrete must be bridged in the supervised practice setting, by the use of case-method simulations or computer assisted instruction (Joel, 1988). Brehm et al. (1999) believes that field experiences in which students are placed in the community for firsthand observation and application are more beneficial than role playing, case studies and similar simulations of professional practice. Regardless of the setting, Holli & Calabrese (1997) believe that educational strategies with active participation by the learner develop research, counseling, and education skills, which are activities essential to the success of dietetics professionals.

Competency is a blend of the knowledge and skill used in experiential learning. Although the balance between these two elements is challenging, it is essential since to achieve competence. This attainment of competence, and competence-based dietetic education is consistent with the Dreyfus and Dreyfus novice-to-expert literature (Gilmore et al., 1997). In the novice-to-expert continuum Chambers et al., (1996) propose that new graduates of supervised practice programs should attain the competent stage. Indicators of achievement, in this case competency, include students' standardized test scores, grade point averages, attainment of course objectives, performance on licensure exams, and job placement (Krichbaum et al., 1994). However, there are limited measures of clinical performance that are valid and reliable; the available studies are reviewed under 'Evaluation of Competency.'

Determining educational requirements for entry to practice is an essential component in development of a profession. Graduates must also demonstrate the ability to communicate and collaborate, solve problems and apply critical thinking skills (ADA, 1996). Karp and Lawrence (1999) evaluated the competency of entry-level dietitians based on employer ratings and self-ratings of graduates in dietetics. Thirty-five employers and 31 graduates returned the 40-item survey based on the new core competencies for entry-level dietitians (ADA, 1996). The employers rated the graduates at scores that exceeded both competent and highly competent ratings; graduates rated themselves at the competent level. Karp & Lawrence (1999) proposed that to add breadth to evaluation of competency, future studies should examine some of the interpersonal skills and traits, which are not included in the core competencies, but are required of a competent professional.

One such study by Kirk et al. (1989) surveyed 300 dietitians from the Dietitians in Business and Industry practice group of ADA and 300 prospective and current employers of RDs. A response rate of 46% and 29% was attained from the dietitian and employers groups respectively. Communication skills were the most desired attribute reported by both dietitians and potential employers in this study. While the assumption has been made that dietetic education programs provide students with the skills to communicate, solve problems and apply critical thinking (ADA, 1996), these skills continue to develop in the supervised practice setting as competency is achieved.

The development of higher cognitive skills such as critical thinking, problem solving, decision-making and communication skills can be accomplished by using cooperative learning in the supervised practice program. These skills are necessary for every dietetic professional according to the Standards of Professional Practice (ADA, 1998). Standard 3 mandates that successful dietetics professionals apply knowledge and communicate effectively with others.

Nutrition diagnosis in dietetic education

The recent emphasis in quality assurance systems in health care delivery is on the use of outcomes of patient care as indicators (JCAHO, 1994). The Institute of Medicine committee has recommended consistency in naming and describing findings, clinical problems, procedures and treatments (Institute of Medicine, 1991), which facilitates the tracking of patient outcomes. Currently, the dietetics profession does not have a common language to effectively track and document patient outcomes for specific nutrition problems and interventions. Beisemeier and Chima (1997) surveyed 500 RDs (response rate 34%) from three practice groups of ADA (Dietitians in Nutrition Support, Dietitians in General

Clinical Practice, and Clinical Nutrition Management) with a high percentage of clinical practitioners. Their results reveal that 93% of responding dietitians favor standardized nutrition diagnosis. Since measuring patient outcomes is imperative, a diagnostic focus would provide a classification system for monitoring activities, resources, and impact on patient outcomes unique to dietetics (Cassell, 1987). Kight (1985) has proposed Dietetic-Specific Nutritional Diagnostic Codes (D-S NDCs) (see Figure 2) which would allow greater utilization of the special training of the dietitian, improve patient outcomes, provide potential reimbursement for services in the diagnosis related group setting and interface with DRGs. According to Kight (1985) the dietitian would:

- Give appropriate consideration to the medical and pivotal viewpoints of other professionals, clients, and client's families;
- Asses the nutritional status of clients;
- Translate assessment into nutritional diagnostic statements and categories (when problems are found);
- Develop plans/orders based upon the nutrition diagnostic statements.

A key professional competency according to Kight (1975) is nutrition status assessment, intervention and outcomes.

The D-S NDC's provide a framework for formally mapping the diagnostic thinking of dietitians and provide levels of clinical decision-making (Kight & Gammon, 1994). The D-S NDC's translate the JCAHO nutrition standard assessment items (JCAHO, 1994) into relevant nutrition problems (Kight, 1995). Oakland (1997) proposes that the D-S NDC's are a tool to reach higher levels of cognition in dietetic education. Nutrition diagnosis is clinical judgment about an individual made by the registered dietitian and represents the use of higher cognition.

D/ Dietetic-Specific Nutritional Diagnostic Codes (D-S NDCs)

Absence of /Limited D1.000
- ☐ Nutrition Service/Professional Nutritionist Contact D1.001

Altered/Alteration In D2.000
- ☐ Body Composition Integrity D2.001
- ☐ Bowel Elimination D2.002
- ☐ Drug Disposition D2.003
- ☐ Metabolism D2.004
- ☐ Nutrient Disposition D2.005
- ☐ Nutritional Biochemistry Integrity D2.006

Conflict In D3.000
- ☐ Feeding and Treatment/Diagnostic Schedules D3.001

Deficit In D4.000
- ☐ Nutrition Education D4.001
- ☐ Nutrition Knowledge D4.002

Dependent on D5.000
- ☐ Home Enteral/Parenteral Product Assistance D5.001
- ☐ Home Food Service Assistance D5.002
- ☐ Home Therapeutic Diet/Product Assistance D5.003

Excessive D6.000
- ☐ Caloric Allowance/Intake D6.001
- ☐ Fiber Allowance/Intake D6.002
- ☐ Protein Allowance/Intake D6.003
- ☐ Vitamin/Mineral Allowance/Intake D6.004
- ☐ Water, Fluids Allowance/Intake D6.005

Imbalance D7.000
- ☐ Electrolyte D7.001
- ☐ Energy D7.002
- ☐ Nutrient D7.003
- ☐ Water, Fluids D7.004

Impaired D8.000
- ☐ Activity Performance D8.001
- ☐ Cognition & Behavior D8.002
- ☐ Fecundity/Fertility D8.003
- ☐ Growth/Development/Function D8.004
- ☐ Home Maintenance of Dietary Needs D8.005
- ☐ Lactation Performance D8.006
- ☐ Social Performance D8.007
- ☐ Work Performance D8.008

Inactive Role In D9.000
- ☐ Maintaining Adequate Nutrition D9.001

Inadequacy D10.000
- ☐ Caloric Allowance/Intake D10.001
- ☐ Carbohydrate D10.002
- ☐ Fat-Essential Fatty Acid D10.003
- ☐ Feeding Route D10.004
- ☐ Fiber Allowance/Intake D10.005
- ☐ Food-Diet Consistency D10.006
- ☐ Mineral D10.007
- ☐ Protein-Amino Acid Allowance/Intake D10.008
- ☐ Vitamin D10.009
- ☐ Water, Fluids/Fluid Balance D10.010

Inappropriate D11.000
- ☐ Caloric Distribution D11.001
- ☐ Dietary Habits D11.002
- ☐ Feeding Route D11.003
- ☐ Food Role Perception/Food Abuse D11.004
- ☐ Protein Distribution D11.005

Intolerance D12.000
- ☐ Drug/Chemical Substance in Food D12.001
- ☐ Food(s)/Nutrient(s) D12.002

Misinformation D13.000
- ☐ Nutrition D13.001

Misuse D14.000
- ☐ Enteral Product D14.001
- ☐ Nutrient Supplement D14.002
- ☐ Other Food Substance D14.003
- ☐ Parenteral Product D14.004
- ☐ Therapeutic Diet/Product D14.005

Nonacceptance D15.000
- ☐ Food Item(s)/Nutritional Product(s) D15.001

Noncompliance D16.000
- ☐ Nutritional D16.001

Possibility of/Possibility of Developing D17.000
- ☐ A Specific Disease D17.001
- ☐ Morbidity, Increased Duration/Severity of Illness D17.002
- ☐ Mortality, Increased Risk of D17.003

Potential Consequences of D18.000
- ☐ Altered Nutrient Function(s) D18.001

Prevention, Decreasing/Eliminating Need for/Use of D19.000
- ☐ Drug Therapy D19.001

Self Assessment Risk Factors D20.000
- ☐ Nutritional D20.001

Suboptimal D21.000
- ☐ Pregnancy Outcome D21.001

Toxicity D22.000
- ☐ Nutrient D22.001

Undesirable D23.000
- ☐ Food-Diagnostic/Treatment Schedule Interaction D23.001
- ☐ Medication-Food/Nutrient Interaction D23.002
- ☐ Metabolic Setpoint D23.003
- ☐ Overweight Status D23.004
- ☐ Underweight Status D23.005
- ☐ Weight (e.g. loss/gain) D23.006

Unwellness D24.000
- ☐ Nutritional D24.001

Other

(D25.000-D50.000 Reserved for Additional General D-S NDCs)

Adapted by MA Kight from:

1. Kight MA et al.: NSS 5 (2) 39-46, 1985.
2. Kight MA: University of Arizona Fairchild Endowment Project Data and Other Publications, 1985-89.
3. Hinds NJ et al.: CRN Quarterly 12 (3) 11-13, 1988.

Figure 2. Kight: Dietetic-Specific Nutritional Diagnostic Codes. Copyright M.A. Kight and Biodietetic Associates. Reprinted by permission from M.A. Kight.

In 1977, Forcier et al. reported that the tasks performed by registered dietitians were predominantly technical activities rather than higher levels of nutritional care, thus a behavioral gap existed between the professed role and that currently being performed. A model (see Figure 3) depicting the posture of the dietitian at various stages of acculturation in practice was created and adapted by Kight (1988) in light of this finding. Acculturation is the process of adopting the cultural traits or social patterns of another group, in this case the professed role of the registered dietitian. The first stage in the model is the diet-oriented professional who is involved primarily in performing the technical activities needed to implement the art of feeding individuals normal and modified diets. This would include

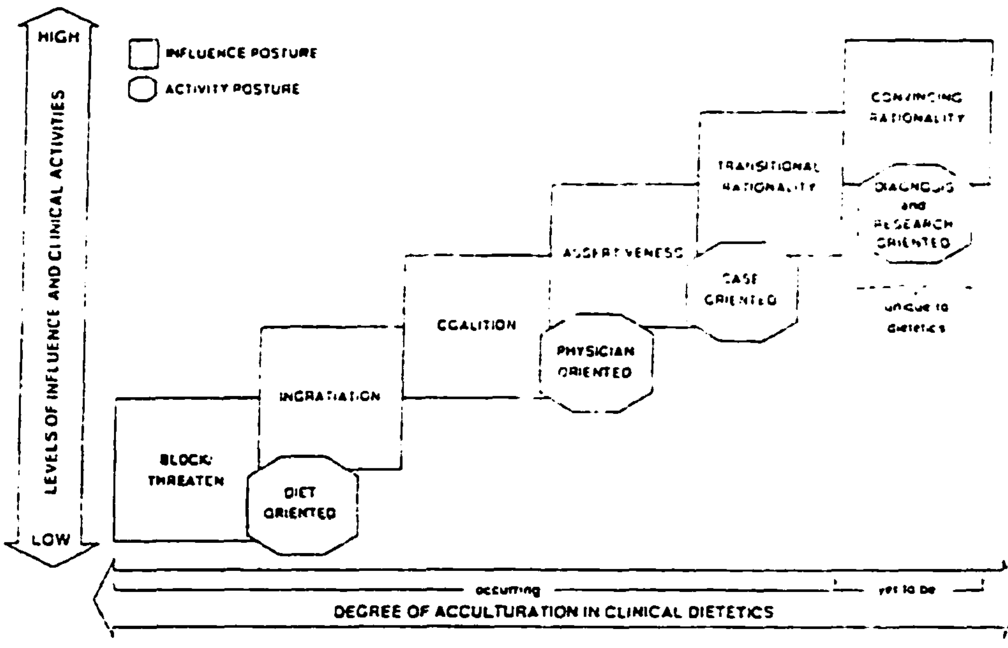


Figure 3. Thomson, Kight, & Longstreth: Acculturation of Dietetics. Copyright The American Dietetic Association. Reprinted by permission from the Journal of the American Dietetic Association.

talking to patients about food preferences and calculating diets. The second posture is the physician-oriented professional involved in performing technical activities for implementing nutritional care as prescribed by the physician in providing food and nutrition information as requested by the physician. A transitional stage occurs as the practitioner proceeds to the third stage; comfort has been achieved with the physician-oriented role but the practitioner is uncomfortable with relative status on the health care team and is frustrated, possessing the expertise to do much more. The third posture is best described as case-oriented with involvement in sophisticated nutrition care services of investigating and assessing the nutrition status of clients, identifying and solving nutrient-based problems and administering appropriate nutrition care as related to the individual. The final posture, analogous to expertise in the skill acquisition model (Dreyfus & Dreyfus, 1986), is diagnosis and research oriented.

Although Thomson et al. (1990) reported that a number of clinical dietitians, members of the Nutrition Support dietetic practice group, perceive themselves to be adopting diagnostic orientation in practice, many continue to function in the diet-oriented or physician-oriented posture. They found that case oriented activities had decreased between 1982 and 1986 which is of concern as 'deprofessionalization of dietitians' (Thomson et al., 1990). This study observed that professional activities, such as conferring with physicians, participating on patient care teams, and attending medical/surgical rounds, of dietitians had decreased between 1982 and 1986. The dietitians also tended to use threatening and ingratiating behaviors when interacting with other professionals to achieve results. In a study at this institution it was observed that The faculty in the DI at ISU, also have observed dietitians performing more technical activities, i.e. nutrition screening, than nutrition assessment and intervention (Kwon, 1999). As registered dietitians continue to strive for greater professional recognition they need to increase visibility and credibility by practicing at a higher level of clinical practice, the diagnosis and research oriented posture. This would provide registered dietitians with more decision-making power within the health/medical system (Thomson et al., 1990). Attaining the diagnosis and research-oriented activity posture requires registered dietitians to become formally involved with the activities of using a human condition code, diagnostic charting, diagnostic care planning guides, and related research findings specific to client centered dietetics (Thomson et al., 1990). Thus, the acculturation model fully supports the D-S NDC's proposed by Kight (1985).

Distance education in dietetic education

Innovations in technology are forcing changes in professional dietetic practice and education (Chambers, 1995). Technology has speeded change and innovation, which has eliminated many low-level, repetitive, and routine tasks within the food and nutrition field (Duyff, 1999). The information technology age is also moving into education, and dietetics training must adapt to new instructional methods and the opportunities of distance learning. To maximize their effectiveness as educators of the next generation of nutrition professionals, nutrition and dietetics educators must be aware of the new multi-media technology opportunities available in nutrition education and training. Multi-media technology can provide the student with experiential training before and during their internship or training experience (Plaisted et al., 1998).

Currently, there is minimal use of computerization in dietetics (Beisemeier & Chima, 1997). They (1997) found that 23% of all clinical registered dietitians use electronic charting some of the time. Yet, a customer satisfaction and needs assessment survey commissioned by the Commission on Dietetic Registration (CDR), reported that 91% of registered dietitians have access to a personal computer, 74% have access to e-mail, 63% have access to the internet, and 68% have access to CD ROM technology (Matthys & Stivers, 1999). This survey was sent to all registered dietitians with a response rate of 13% (N= 9126). McDonald (2000) states that there are few studies looking at the computer skills of registered dietitians and there are no studies investigating the internet skills of the registered dietitian and feels that registered dietitians are lacking in intermediate to advanced skills. Gilmore et al. (1997) reported that computer communication was one of the competencies for entry-level dietitians least likely to be taught in their educational programs. Computer use has been correlated with experience and access, and the internet was used as a resource for professional and client information (Johnson et al., 1999). Many dietitians do not use the computer for charting purposes as Foltz et al. (1993) reported that 40% of nutrition support dietitians never used any type of computer and fewer than 20% expressed any interest. It is critical for dietitians to develop and use these skills to survive today's technological 'information age'.

The development of the registered dietitian's skills with information technology meets a Standard of Professional Practice, 'uses resources effectively and efficiently in practice' (ADA, 1998). Technology has made information more accessible, which makes for an increasingly informed and educated clientele. This brings increasingly greater expectations and a decreasing tolerance for ambiguity in the information provided by health care professionals (McCaughan, 1998). Competence in health care professions depends on information literacy (Duyff, 1999) because solutions for today's problems are no longer found in textbooks. Health care industry professionals and the academic health care community must use technology to keep one step ahead of the customers, patients and students. Retrieval of health-related information is the second most popular category on the World Wide Web and diet and nutrition information, the second most popular subcategory, makes up 36% of health-related searches (Graphic Visualization, 1998). There are more than 15,000 health websites with nutrition and disease-related information (Miller and Reents, 1998). However, Sutherland (1999) claims that numerous websites contain inaccurate or outdated information thus, students must be taught to critically evaluate World Wide Web sources (Funke, 1998). The registered dietitian must be skilled at accessing and networking this large volume of data quickly; they also need to evaluate, interpret, and synthesize it to use it creatively and effectively.

The incorporation of educational technology into all coursework within biomedical curricula from 47% to 50% between 1995 and 1996; within the health sciences curricula, it rose from 33% to 40% (A Market View, 1997). Various modes of communication technology have been used to deliver nursing education at a distance (Cragg, 1994; Landis & Wainwright, 1996; Alloy, 1996) and it appears that these distance education students perform at the same level or better (Dresler-Viverais & Kutschke, 1992; Hegge, 1993). Cooperative learning has been used in some online healthcare training programs (Carter & Lewis, 1998) but references in the literature was not located for dietetic supervised practice programs.

Technology in dietetic education remains limited, although there has been growth in the past 4 years. At the 1998 ADA Annual Meeting and Exhibition there were a number of programs reporting on the inclusion of technology in dietetic education (Plaisted et al., 1998; Strauss & Dahlhemier, 1998; Evers et al., 1998; Turner et al., 1998). Yet, the research available is minimal due to the numerous types of technology, recent changes in pedagogy, and variability of how it is used in dietetic education and training. Although distance education is a component of 23% of all dietetics programs (Commission on Accreditation for Dietetics Education, 2000) only three supervised practice programs (two dietetic internships and one AP4) are considered distance education format by the ADA (Anderson, 1999).

Computer aided instruction is an efficient and effective method for teaching basic nutrition competencies to health professionals including dietetic students (Engel et al., 1997; Raidl et al., 1995; Lyons et al., 1998; Weis & Guyton-Simmons, 1998). Strauss and Dahlhemier (1998) reported significant improvement in post test scores after implementing multimedia technology (color, sound, and motion using computerized multimedia images, animations, and the internet) into a course covering gastrointestinal anatomy and physiology. Turner et al. (2000) had 108 dietetic interns in 8 different programs use three computer-based simulations of patients with cardiovascular disease. In the subsequent eight weeks the interns were evaluated on obtaining data, interviewing client, analyzing data, and developing plan by their clinical preceptors on a weekly basis. The researchers did not observe skill improvement using a computer-based simulation system over the alternative computer tutorial. The interns'skill development was evaluated by clinical preceptors in four categories of nutrition care planning: obtaining data; client interview; data analysis; and plan development. However, they did find a faster rate of skill development and enhanced skill acquisition in dietetic interns. Evers et al. (1998) investigated care-planning strategies used by 55 dietetic interns from eight different programs using the same three computer-based simulations of patients with cardiovascular disease. After completion of the nutrition care plan a series of feedback screens including how a panel of experienced dietitians had approached the patient was provided. They found that providing this feedback and describing actions of experienced dietitians in simulations was an effective way to foster appropriate assessment and care planning strategies; the interns were using the same care planning strategies as the experienced dietitians by the third simulation. Computer simulations encourage greater emphasis on competence and clinical judgment (Wooley & Costello, 1988). Plaisted et al. (1998) also found improved student learning and retention in this study of 39 students using a CD ROM module on nutrition and cancer in an introductory medical nutrition course.

Lifelong dietetic education

As past-President of the American Dietetic Association, Polly Fitz noted: "Future dietetics professional...must engage in lifelong learning to stay current, not only with food, health, and nutrition, but also with marketing trends and technologies" (Fitz, 1997). Lifelong learning is a continuously supportive process which stimulates and empowers individuals...to acquire all the knowledge, values, skills and understanding they will require throughout their lifetimes...and to apply them with confidence, creativity, and enjoyment in all roles, circumstances, and environments (American Council on Education, 1997). The Commission on Dietetic Registration (CDR) defines lifelong learning within the context of dietetics: "Responsible lifelong learning is continuous learning that is self-initiated, self-directed, and self-evaluated...and undertaken for the purpose of professional development, personal enhancement or quality of care improvement" (CDR, 1996). The dietetics professional assumes responsibility and accountability for personal competence in practice, continually striving to increase his or her knowledge and skills and to apply them in practice (ADA, 1999). In fact the Standards of Professional Practice (ADA, 1998) include "Continued competence and professional accountability – engages in lifelong self-development to improve knowledge and skills that promote continued competence."

Lifelong learning is necessary to attain and maintain the 'expert' level of practice in the skill development model by Dreyfus and Dreyfus (1986). Attaining expertise is not the result of dietetic education and training programs, and it requires lifelong learning to continually keep abreast of new advances in research and technology coupled with a significant amount of work experience beyond the dietetic internship. To maintain this expertise also requires lifelong learning skills to continually keep abreast of new advances in research and technology. The 'expert' professional may also find him/herself in the role of the novice if they choose to change their area of practice during their professional career. For example, the expert cardiac dietitian will be the novice renal dietitian. At this point the skill development model holds true for developing a new specialized skill. Lifelong learning skills plays an important role for not only the entry-level dietetic professional but the expert as well.

Health care providers will work in more isolated settings as community-based health care increases and online technology provides a means for these providers to update and learn new skills. Use of distance education in health care training and continuing education can help reduce professional isolation and enable rural health care providers to be exposed to the latest information (McCaughan, 1998). Additionally, the growth of managed care makes the acquisition of advanced degrees for additional formal certifications essential for health professionals to remain competitive and marketable (McCaughan, 1998). Changes in health care regulation and accreditation spurred by technology, downsizing and reorganization have made it necessary for the health professions, including dietetics, to adopt lifelong learning.

The lifelong learning that begins during the supervised practice must continue for the professional to keep up with current research and developments in their field and maintain their licensing and certification eligibility (American Council on Education, 1997). In keeping with the novice-to-expert model by Dreyfus and Dreyfus (1986), further growth in the profession from competence to proficiency can only be accomplished by a combination of on-the-job training and self-initiated and self-monitored learning (Gilmore et al., 1997). Depending on the field of study, knowledge doubles every 3-10 years and the life of dietetics knowledge is only about 3 years (Duyff, 1999). This is forcing professionals to continually improve their competency through lifelong learning. The 1994 Future Search Conference cosponsored by ADA and CDR identified professional accountability for continuing competence as a top priority (ADA, 1994).

Continuing education and degree programs for health care professionals are increasingly available using a variety of communications technologies (Puskin, 1993). This helps health care professionals, including registered dietitians, break down the barriers frequently encountered for continuing education activities such as time, resources, access, and coverage at work (Armstrong & Mahan, 1998). Thus, the use of online technology, which incorporates interactive simulations and opportunity for practice will benefit not only the supervised practice experience but the dietetics professional engaging in lifelong learning.

Evaluation of Competency

There has been a decline in the public's trust of healthcare professionals, and consumers today are demanding accountability in many arenas. In 1967, the National Advisory Commission on Health Manpower recommended that government regulatory agencies and professional associations establish procedures to aid practitioners in maintaining competence, spurring the movement to mandate continuing professional education (CPE). Mandatory CPE became an integral part of the continuing registration certification of dietitians when registration was established in 1969 (Inman-Felton & Rops, 1998). However, thirty years later, another surge of public outcry for assurance of competency and quality service from health professionals is heard, competence is being scrutinized and challenged more than ever before (Inman-Felton & Rops, 1998). In 1995, the Pew Health Commission recommended state legislators demand changes in health care regulation and that professionals be more accountable stating, "continuing education requirements alone does not guarantee competence" (Pew Commission, 1995). Society no longer accepts the assumption that attendance at professional conferences results in improved competency (Duyff, 1999). In fact, a review of continuing medical education literature reported that formal delivery methods such as conferences, without practice-reinforcing strategies, have relatively little impact on performance in practice (Davis et al., 1995). Although knowledge provides a foundation for improved practice, does possession of new knowledge equate to competent performance?

In response to these demands, government, accrediting, and professional organizations are actively recommending competency-based evaluation of practitioners. In health care the accrediting agency JCAHO, has standards that require the competence of all hospital staff members be assessed and maintained, and states that "documentation of certification through continuing professional education is not enough" (JCAHO, 1998). The Commission on Dietetic Registration's (CDR) mission is to protect the public by attesting to the professional competency of dietetics practitioners. To carry out this mission the CDR has developed competency statements for entry-level dietitians by which dietetic education programs are evaluated and accredited (ADA, 1996). Undergraduate education and supervised practice are the initial contributors to the dietetics professional's entry-level competence (Inman-Felton & Rops, 1998). The CDR has strengthened its re-certification system with a Professional Development Portfolio (Inman-Felton & Rops, 1998) which demonstrates/provides evidence of competence (Dahl & Leonberg, 1998).

Some common methods used by educators, trainers, and employers to assess competence include interviewing, verification, observation, peer review and testing (Inman-Felton & Rops, 1998). Interviewing is the most common method used to assess competence of a job applicant. It has been suggested that behavior-based interviewing better predicts success on the job than traditional interviewing (Hirschman, 1998). Verification is the collection and documentation of education, experience, registration, licensure, specialty certification or advanced training. Observation consists of a supervisor or qualified peer observing the performance of a staff person. In peer review, a supervisor or qualified peer reviews the staff member's documentation in patient records, charts or other written documents. Testing involves the administration of an assessment requiring demonstration of knowledge, psychomotor, critical thinking or interpersonal competencies.

One of the strongest measures of competence in clinical judgment is outcome-oriented performance measures (Inman-Felton & Rops, 1998). There have been several approaches to evaluate competence of clinical judgment, within a rationalist paradigm. Typically one of two goals is addressed – comparing performance of clinicians in deriving a decision with that prescribed by an algorithm prescribed by a statistical model or describing the actual thought processes used by clinicians in deriving a diagnosis or determining appropriate interventions (Tanner, 1987). However, little is known about how to measure a expert practitioner's ability to recognize and look for problems because they use qualitative assessment of the whole situation. Evaluation of expert clinical judgement requires interpretative and qualitative measures (Benner, 1984; Pavlish, 1987) such as case studies, clinical scenarios, and patient care vignettes (Gurvis & Grey, 1995) – tasks one would be expected to perform in real work settings (Chambers et al., 1996).

Methods to evaluate competency

Evaluation depends upon the competency being assessed, it is simplistic to presume that any one method can adequately assess all the knowledge, skills, and personal qualities which make one competent (Norman et al., 1985). Psychomotor competencies are best evaluated by observing the learner demonstrate, whereas affective and cognitive competencies can be validated with role play, group discussion, case study analysis and post-tests (Gurvis & Grey, 1995). Some commonly used competence assessment tools include a competency checklist, chart audit, written or performance examination and self-assessment (Inman-Felton & Rops, 1998). The competency checklist involves observation of the examinee by a verifier who 'checks off' competencies as they are demonstrated. A review of the examinee's patient charts to assess compliance with established standards or procedures occurs with the chart audit. Written, simulated, or live demonstration of one's competencies can occur with written or performance examinations. Self-assessment consists of a collection and analysis of data concerning one's competencies to identify strengths and learning needs.

One method of evaluation that has been employed in medical and other health care professions is the objective structured clinical examination (OSCE) (Black et al., 1986; Good et al., 1986; Robb & Rothman, 1986; Woodward et al., 1986; Harden et al., 1975). An OSCE is a multi-station examination in which 'standardized patients' have been taught to portray a problem that does not vary from student to student. There has has been a renewed interest in using direct methods such as OSCE to assess student performance, or competency, on significant tasks that are relevant to life outside of school (Worthen, 1993). OSCE offers the advantages of increased exam reliability, increased perception of fairness by students and authenticity using uncued, open-ended assessments (Ferrell, 1995). Using standardized patients to evaluate students has been shown to be valid, reliable, and cost-efficient by medical educators (Rethans & Saebu, 1997). Other formats similar to the OSCE include the simulated clinical encounter, objective clinical exam (Petrusa et al., 1986), clinical practice examination, objective procedural clinical examination , diagnostic management problems (Helfer, 1971), patient management problems (Rimoldi, 1961), and simulated management problems (Williamson, 1965). These performance assessments evaluate mastery of a defined domain of knowledge or skill to judge whether the student is competent in relation to the domain (Ferrell, 1995). OSCE is thought to be more objective than the other formats (Ferrell, 1995). However, these tools including OSCE, have been reported to exhibit little relationship to performance in clinical practice (Page & Fielding, 1979) and there is low correlation across problems presented in the assessment (Swanson, 1984; Norman et al., 1985). This low correlation indicates that clinical decision-making skill is not a general skill but is content specific to individual cases or problems (Swanson, 1984) and multiple cases are needed to provide a general measure of competence (Norman et al., 1985). In addition, there is a strong correlation between OSCE and multiple-choice examination performance, which suggests that OSCE may just be another assessment of knowledge rather than problem solving and clinical decision-making abilities (Norman et al., 1985). Currently, there is limited use of OSCE in dietetic education, including the internship (Rhoades, 1997).

Connolly-Schoonen (1998) developed an OSCE for the Dietetic Internship at Stony Brook. New York under the Dietetic Education Innovations Grant program sponsored by the ADA.

The performance evaluations previously discussed require significant time, labor and expense (Good et al., 1986; Joorabchi & Devries, 1996), which limits many educational institutions and accrediting agencies to paper-and-pencil tests. Unfortunately, the main point is the multiple choice test, which the ADA currently uses to grant registration status, are generally multiple choice questions and are an assessment of isolated factual knowledge. This may not reflect that experts know more than novices (Chambers, 1993; Bruer, 1993; Dreyfus & Dreyfus, 1986; Frederiksen, 1984a; Bashook, 1976). A blend of these two, OSCE and multiple choice, methods of evaluation may be the 'key-feature' exam. Bordage and Allen (1982) proposed this type of examination because they found that most diagnostic errors (57%) can be attributed to cue interpretation rather than knowledge deficiencies in a study in which 59 subjects, including general medical practitioners, interns, clerks and nurses, from different levels of clinical experience completed ten case studies. The subjects recorded their diagnostic impressions for each case in addition to the specific actions that they would take to complete the assessment (i.e. physical examination, order laboratory tests, etc.). Page and Bordage (1995) propose that clinical decision-making skill is contingent on the effective manipulation of a few elements of the problem that are crucial to its successful resolution – the problem's 'key features'. A key-feature is defined as the critical step in the resolution of a clinical problem, which focuses on a step in which examinees are most likely to make errors and it is a difficult aspect of the identification and management of the problem in practice. The key-feature problem consists of a clinical case scenario followed by questions that focus only on those critical steps where errors are most likely to occur (Page et al., 1995). The examinee is evaluated on ability to use knowledge in solving problems and on the processes involved in the resolution of the problem, such as interpreting clinical cues to formulate a diagnosis or acquiring additional data to determine a course of action. The shorter length of the examination also facilitates testing a greater number of specific cases and problems necessary for evaluating clinical decision-making skills than could be tested with an OSCE system.

Diagnosis, identification of problems, is an important clinical problem-solving skill that reflects competency and ultimately the quality of health care (Norman et al., 1977). Therefore, the ability to appropriately diagnose could be used to evaluate competency. The Dietetic-Specific Nutritional Diagnostic Codes (D-S NDCs) proposed by Kight (1985), which complement medical and nursing diagnostic classification systems (Kelly, 1997), provide another opportunity for evaluation of dietetic practitioner competency.

To be of value, an assessment tool must be valid, reliable, and fair (Gall et al., 1996). If a tool is valid it actually measures what it says it measures. To be reliable the test will produce the same measure consistently and repeatedly. Establishing construct-related validity for competency is problematic due to the lack of gold standards for clinical competence. It is difficult to obtain consensus, much less agreement, among clinicians about what constitutes minimally acceptable or borderline performance level required (Ferrell, 1995). This is particularly true of dietetics where documentation of nutritional diagnoses, interventions, and outcomes is scarce. An assessment tool is fair if there is equal probability for success by all individuals assessed. To ensure that tools are valid, reliable, and fair it is important to seek diverse representation in the development and review of the tools. Validity and reliability are particularly problematic when competency is being evaluated; these tools of evaluation must attain a higher degree of reliability than those used primarily for teaching or providing feedback to students (Ferrell, 1995).

CHAPTER 3. METHODS

Program expansion was planned in the DI at ISU pursued between 1998 and 2000 in response to a shortage of internship programs for dietetics graduates. An internship is necessary for dietetics graduates to be eligible to take the registration examination and become a Registered Dietitian (RD). Over the past five years there has been nationally approximately a 50% match rate for dietetics graduates pursuing a dietetic internship position. In the April 2000 Computer Matching process 2,576 dietetics applicants applied for an internship position and 66% received an internship appointment (Commission on Accreditation for Dietetics Education, 2000). This is slightly higher than previous years, however, there was also a decrease in applicants (10%) from the previous year.

To facilitate this program expansion, a distance education format was adopted. Because preceptors in facilities in central Iowa were unable to handle additional interns, facilities in a 250-mile radius of the university were identified as possible sites to place interns to facilitate the expansion of the program (see Figure 4). Fifteen counties in the State of Iowa do not have a licensed dietitian residing in them and an additional 53 counties have a population to dietitian ratio greater than 5000:1 (see Figure 5; Iowa Department of Public Health, 1999). Including these communities as preceptor sites in the DI brings nutrition services to these underserved areas and increases the likelihood that the interns might choose to practice professionally in this type of setting.

A coordinator was identified at each preceptor site to provide personal and social support in the instructional process. Site coordinators gather holistic perspectives of the student's learning styles, initiate some educational counseling, and provide advice

Geographic Locations of ISU Dietetic Internship Preceptors as of March 2000

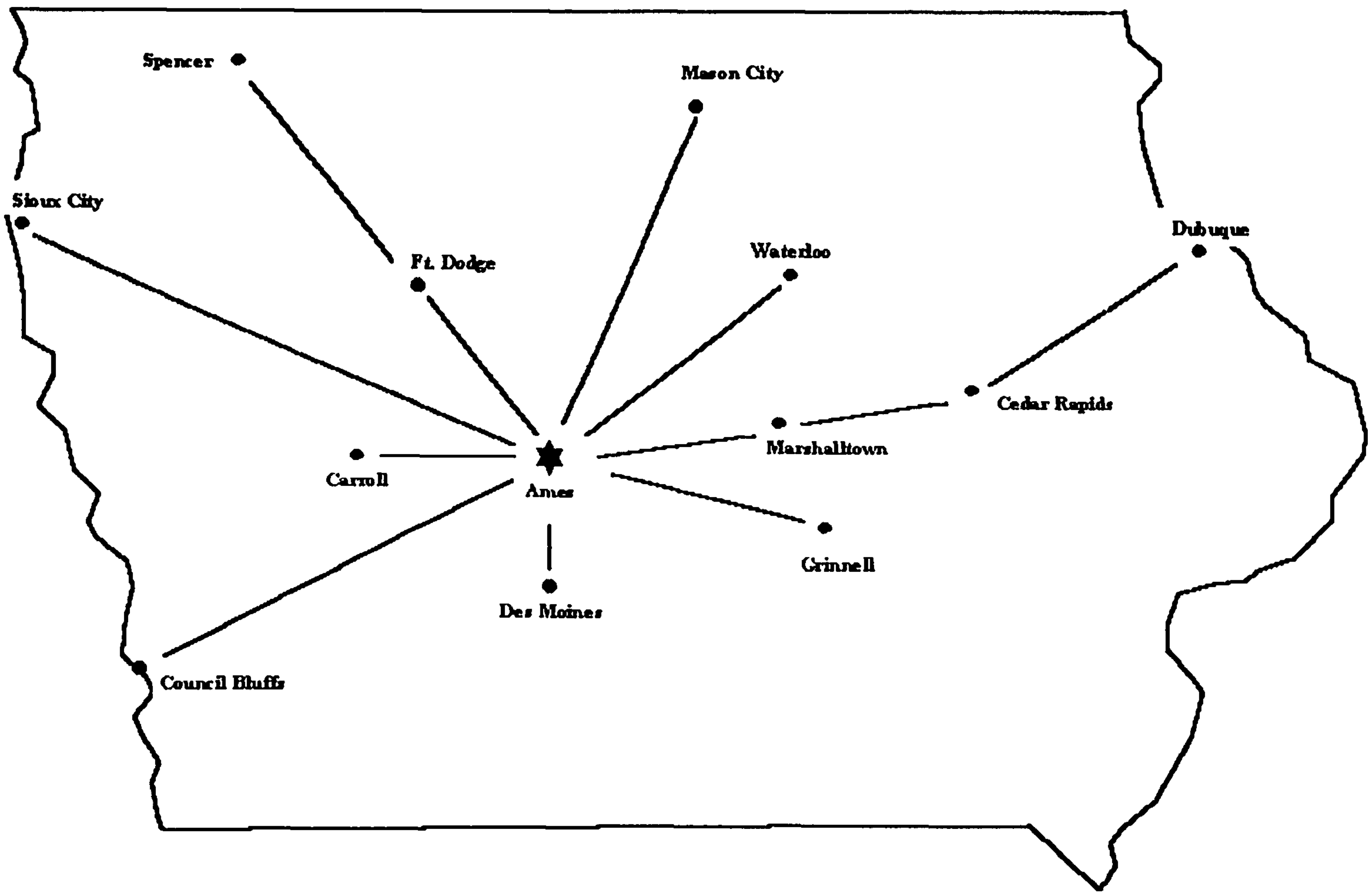


Figure 4. Geographic locations of the Dietetic Internship

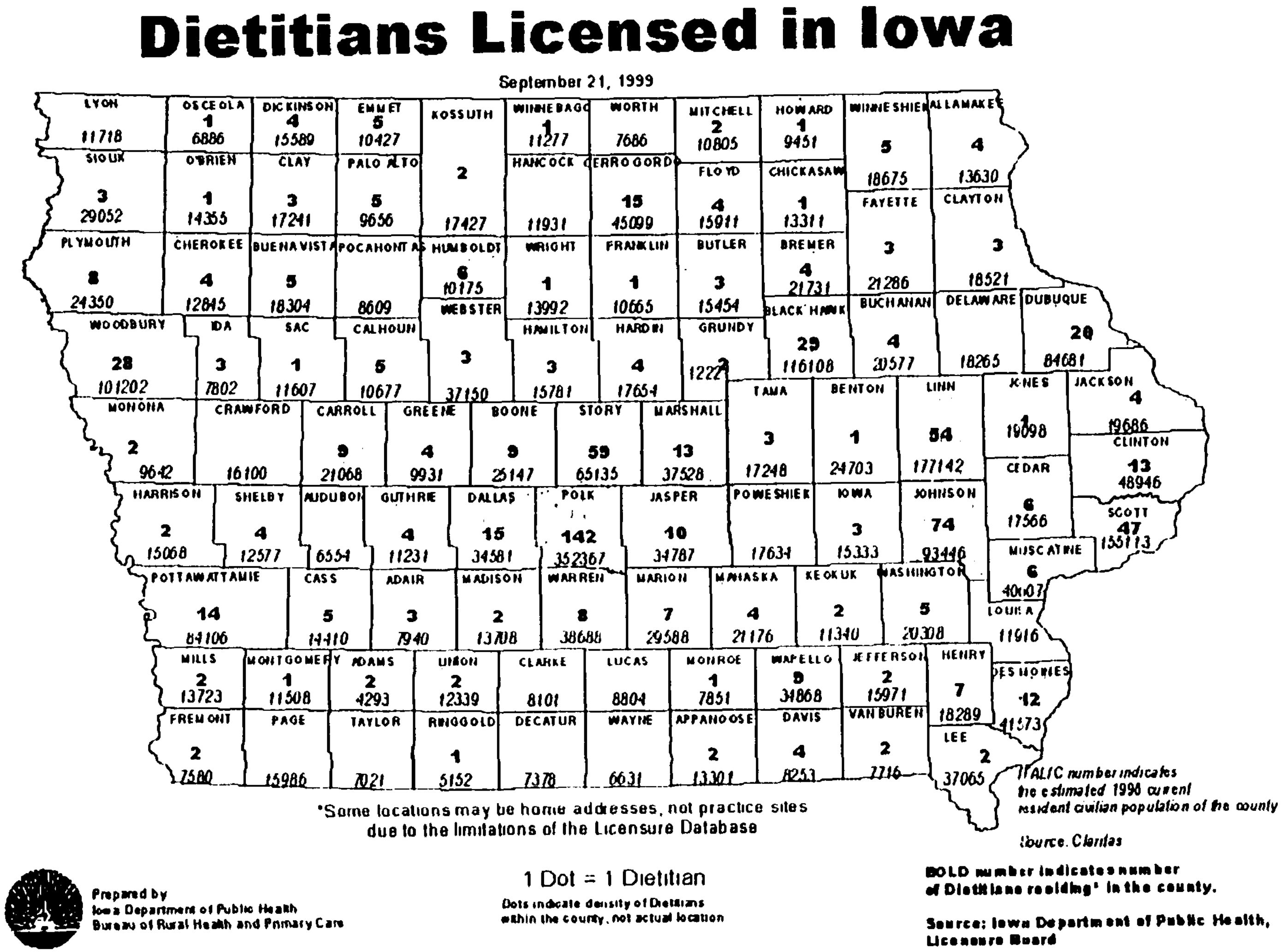


Figure 5. Geographical dispersal of dietitians in the state of Iowa.

specific to the student's educational progression. This essential two-way feedback is important for both the faculty and the students to achieve successful progression and implementation throughout the DI. It also eases the feelings of isolation felt by the student. The site coordinator plays an important role as assistance is often needed to demonstrate or clarify information and assist in the socialization into professional practice.

Online technology is used to provide the instructional support necessary to ensure student and program success in this distance education format. Online technology offers many instructional opportunities. But, for the technology to do its job, it must have excellent content, support systems for learners at a distance, and the commitment of both the provider and the participant (McCaughan, 1998). Many of the educational/instructional theories described previously were incorporated throughout the development of this online instruction. Although personal computer ownership and internet access have grown significantly, the program staff of the DI did not want to discriminate against any applicant without this technology; thus, precepting facilities were surveyed to identify availability/accessibility of online computers and hardware/software configurations. Results from the survey indicated that each of the precepting facilities (including small rural facilities) had a computer with internet access, usually in the medical library. In some cases, upgrades of memory or sound cards were provided to the facilities. The minimum requirements established for this online instruction project were a pentium or greater processor, Microsoft Windows 95 or newer, 16 MG of RAM or more, 28.8 modem or more, 4x CD ROM or greater, super VGA display card supporting 16 bit color, 32 bit sound card, and Netscape Navigator 4.0/Communicator or newer.

Development of Online Instruction

WebCT (WebCT version 1.3.1; Peabody, MA), the groupware software supported by the university, was used to develop, structure, deliver and manage components of the curriculum and learning experience. The WebCT student features used in the DI include: electronic mail and bulletin boards, general and individual chat rooms, glossary, indexing, searching, page annotation, external web site links, learning goals, on-line quizzes and the calendar tool. The WebCT instructor features used include: student progress tracking, quiz administration and management, student management, access control, and course backup and transfer.

To accommodate the various style of preferred learning a variety of instructional techniques were included throughout the online instruction:

- text for those preferring to learn by reading,
- audio clips for those preferring to learn by listening,
- graphics, animations, and video for visual learners preferring to learn by observation and demonstration,
- an annotation tool for those preferring to learn by 'taking notes' or writing,
- cooperative learning strategies for those preferring to work with others,
- interactive calculators for those preferring to learn by doing,
- and the capstone activity, a simulation, for those who preferring 'hands on' or active experimentation.

Key to the development of this online instruction was fostering competence in the dietetic intern. Because competence is a blend of concept/principle and action/skill knowledge, it was imperative that the online instruction bridge these two kinds of knowledge. This involved the initiating the higher levels of cognition in Bloom's taxonomy including analysis, synthesis and evaluation. Cooperative learning has been shown to increase the use of higher level reasoning strategies and develop problem-solving skills necessary for higher cognitive function. Cooperative learning is particularly relevant to the DI where preceptor diversity adds to the breadth of the practicum experience when shared among the interns. The collaborative, engaging, and problem-based learning environment of cooperative learning merges well with the Engagement Theory of online instruction. The variety of learning strategies incorporated into the online instruction suited a variety of learning styles and engaged the learner in the process. The online instruction also promoted self-directed learning by the use a glossary, indexing, external hyperlinks and target questions on each page for the intern to explore the material in greater depth. The development of self-directed learning is important to foster the lifelong learning skills so necessary to professional practice.

Three modules of the medical nutrition therapy rotations (nutrition support, pediatric nutrition, and renal nutrition) were converted to an online instructional format and their educational effectiveness evaluated. These modules were chosen due to the complexity of the subject matter and the option of receiving graduate credit for this part of the DI. Each module consists of webpages with scrollable text, graphics, audio clips, animations, interactive calculators, video clips, and a patient simulation. The scrollable text was created first using the html software Pagemill (Adobe Pagemill version 3.0). This text provides an overview of physiology and nutrition principles for each module to provide background knowledge base for each module. The content for each module was determined by reviewing the ADA Core

Competencies for Entry Level Dietitians, as well as feedback received from preceptors and previous interns. Each module's content was reviewed by two expert practitioners and three ISU faculty to ensure appropriateness. The modules begin with a page outlining the activities to be completed by the intern during that rotation and written assignments to be submitted to the instructor. Assignments may be mailed or e-mailed as an attachment to the instructor. A list of vocabulary, medications, and lab values relevant to the rotation is included on the second page for the intern to become familiar with prior to the rotation. The intern also takes a timed ten-point pretest prior to completing the module; a timed ten-point posttest follows the completion of the module. The following is an outline of pages for each module:

Nutrition Support

1. Rotation Activities/Assignments
2. Vocabulary, Medication, Laboratory Lists
3. Nutrition Support
4. Enteral Nutrition Support
5. Feeding with Enteral Tubes
6. Monitoring Enteral Support
7. Enteral Calculations
8. Enteral Calculations
9. Enteral Complications
10. Parenteral Nutrition
11. Parenteral Solutions
12. Solution Administration
13. Monitoring Parenteral Support
14. Parenteral Calculations

15. Parenteral Calculations

16. Parenteral Complications

17. Nutrition Support Flowchart and Simulation

Pediatric Nutrition

1. Rotation Activities/Assignments

2. Vocabulary, Medication, Laboratory Lists

3. Birth - 12 Months

4. Low Birth Weight Infant

5. 1-6 years

6. 6-12 years

7. 12-18 years

8. Failure to Thrive

9. Cystic Fibrosis

10. Type 1 Diabetes

11. Children with Disabilities and Simulation

Renal Nutrition

1. Rotation Activities/Assignments

2. Vocabulary, Medication, Laboratory Lists

3. Kidney Physiology

4. Kidney Function

5. Kidney Function

6. Kidney Diseases

7. Renal Failure

8. Transplant

9. Dialysis or RRT (Renal Replacement Therapy)

10. Complications

11. Diet Planning

12. Monitoring Labs

13. Nutrition Support

14. Case Study and Simulation

Glossary terms and relevant websites are hyperlinked within the text content. Each page of the modules is indexed by topic and includes target questions, which serve as learning goals and an annotation tool where the interns can create personal notes.

Once the text content was selected, the Instructional Technology Center (ITC) was contacted to create the graphics, animations, interactive calculators, video and simulations to make the modules more visually interesting. A creative team consisting of the researcher, graphic designer, instructional specialist, and media production specialist was assembled. A key concern during development was usability, or ease of use, since the computer skills of the subjects and staff at the distant healthcare sites serving as preceptors was unknown. The minimum hardware/software requirements established by the survey of preceptors were considered during all of the multimedia development. Graphics, animations, and video clips were incorporated to visually display difficult concepts. Interactive calculators created with customized Javascript routines allow the interns to practice calculating renal diets and nutrition support regimens. An interactive case study or simulation was included in each module as a capstone activity. Each patient simulation is representative of the content area with relevant and irrelevant information to perform a nutrition assessment and plan appropriate interventions for various situations. This followed the example of Elstein et al. (1978) who demonstrated that instructional strategies should include both relevant and irrelevant facts to improve clinical decision-making skills. The simulation provides feedback on the appropriateness of the intervention chosen by the intern and rationale for the preferred intervention. The video clips and patient simulation are included on a CD-ROM, which the intern accesses from a 'button' on the web page. A CD-ROM was cut for each module because downloading the videos and simulations over the internet is very time-consuming and inefficient. Information selected for placement on the CD-ROM was considered more constant not requiring continual updating and revision, while more variable material was kept online to facilitate regular updates and revisions.

After the graphics, animations, interactive calculators, video clips and simulations were incorporated into the scrollable text the researcher reviewed the materials to determine where audio clips would be included. Audio clips were used to further explain difficult concepts, describe graphics or animations, and provide instructions. The audio clips were recorded in a sound studio and the files linked to the appropriate pages of the module with 'buttons'.

Communication tools within WebCT are imperative to promote cooperative, interactive learning. For example, a cooperative learning strategy called the jigsaw is incorporated using the chat room. The information for a clinical case study is divided into four separate pieces and each intern receives only one piece of the case study information. The intern is responsible for mastering his/her part of the material and then the interns are assigned to different chat rooms where they are 'teamed up' with interns from other facilities that have the remaining pieces of information to complete the case study as a team. Because each student only receives one part of the case study he/she is dependent on the remaining members of the team to complete the case study.

Peer review is another form of cooperative learning incorporated into this distance education project. The pediatrics module includes an interactive simulation requiring the interns to make recommendations to a 24 hour recall which is posted on the bulletin board for peer review. Each week the student is also expected to participate in a scheduled chat room, bulletin board assignment, and electronic mail journal.

Computer Attitudes Survey

A computer attitude survey was conducted prior to and at the completion of the internship in both control and experimental groups (see Appendix A). The survey was administered to: 1. Determine if an intern's pre-existing attitudes, self-efficacy and comfort using computers would influence performance in this technology intensive internship, and 2. Determine if the comfort and perceived usefulness of technology could be improved with the use technology in the internship.

The Attitudes Toward Computer Technologies (ACT) and Self-Efficacy for Computer Technologies (SCT) instruments developed by Delcourt and Kinzie (1993) were used to assess the computer attitudes and self-efficacy in this study. After review of the instrument by an expert panel (n=17) the instrument was revised and administered to 328 undergraduate and graduate students enrolled in education courses at six universities across the country. Principal component analysis was used to examine the internal consistency reliability of the instrument. A total of 19 items were used for the attitude instrument, 11 measuring Usefulness (for example, "Using computer technologies to communicate with others can help me to be more effective professionally") and 8 measuring Comfort/Anxiety ("I feel comfortable about my ability to work with computer technologies"). The items were equally balanced between positively and negatively phrased statements. A thirteen item self-efficacy instrument using the world wide web (WWW) (for example, "I feel confident managing more than one web browser window") was adapted from the 25 self-efficacy items that reflected word processing, electronic mail, and compact disc (CD-ROM) by Delcourt and Kinzie (1993). A Likert scale with a 4-point response format was used for both instruments using descriptors ranging from *strongly disagree* (1) to *strongly agree* (4). Higher scores in each of the scales reflect a more positive attitude toward computers including perceived usefulness, comfort with computer, and self-efficacy with the WWW.

A scale to rate self-efficacy potential for behavior change was adapted from that published in Williams (1996). A 5-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (5) was used for subjects to respond to ten statements (for example, "Your desire to improve your computer skills"). This self-efficacy scale was used to ascertain subjects' self-efficacy towards technology in general, in contrast to the self-efficacy scales developed by Delcourt and Kinzie (1993) which examine specific tasks within the technology (WWW, e-mail, word processing, etc.). This score was collected only during the pretest to determine the subjects' perceived potential for behavior change.

The survey administered to interns prior to module use also included questions to determine the subject's familiarity with technology by asking questions such as, "During the past year, in a typical week how much time have you spent using a computer for any reason at home, work or school?" Subjects also were asked to identify, from a list of nine, the ways in which they preferred to learn (i.e. listening to instructor, reading, observing, etc...). These survey items were adapted from the Web Course Student Post-Survey used at Kansas State University (Division of Continuing Education, 1998).

Key Feature Exams

Two key features exams were developed for each of the modules to serve as pre and post-tests of clinical decision-making for both control and experimental subjects (see Appendix B). The key feature exams were developed according to the protocol outlined by Page et al. (1995). The expert practitioners that reviewed the content of the modules also assisted with the development of the key feature exams. Each practitioner identified two domains, or nutrition problems, within their area of expertise (nutrition support, pediatrics, renal nutrition) that an entry-level dietitian would be expected identify and manage competently. A clinical scenario was developed using a typical presentation of the nutrition problem identified by the practitioner. For each nutrition problem, 3-4 key features were identified that an entry-level practitioner should recognize to identify the nutrition problem and proceed with the best medical nutrition therapy. In addition, 3-4 Dietetic-Specific Nutrition Diagnostic Codes (D-S NDCs) were identified in each domain. The key feature exams were scored by calculating the percentage of correct responses.

Subjects

Subjects for this study (N=75) were completing the supervised practice component of their preparation to become an RD from three universities (Iowa State University-ISU, Kansas State University-KSU, and East Carolina University-ECU). KSU and ECU were invited to participate in the study because they also use geographically dispersed clinical facilities in their supervised practice programs. Three classes in the DI at ISU participated in the study, one class served as the control group (N=10) and two classes served as experimental groups (N=22). One intern in an experimental group at ISU withdrew from the DI resulting in N=21 for the ISU experimental groups. Two classes in the Coordinated

Program (CP) at KSU participated in the study with one class as control group (N=10) and one class as experimental group (N=12). One internship class at ECU (N=22) was divided equally into control and experimental groups. Multiple sites were included in the study to evaluate wider application of the online instruction, adding breadth to the study. Collection of the data from parallel sites also shortened the study time, which was important because the field of distance education is changing rapidly. The control groups had the same practicum experiences (type and duration) and access to e-mail and bulletin board communications as the experimental groups. The only difference between the two groups was access to the online instructional modules.

Protocols in accordance with the Human Subjects Review Committee at ISU were followed throughout the study. The study was reviewed and received approval (see Appendix C). An informed consent describing the study (see Appendix D), voluntary nature of participation, and option to withdraw without consequence, was signed by each subject before beginning the program. Each subject was assigned a numeric code for all analysis in the study to assure anonymity and confidentiality. Demographic data including age, sex, overall grade point average (GPA), science GPA, didactic coursework GPA, and work experience were obtained from the subjects' DI or CP application form. The amount of work experience (in hours) and type of work experience (foodservice management, community or clinical nutrition) were determined from each subject's work history from the supervised practice application form. Performance on the RD exam was obtained from the American Dietetic Association – Commission on Dietetic Registration which includes the overall score as well as the food and nutrition and management subscores. Results of the computer survey and key-feature exams were collected for both the control and experimental groups. The number of hits (number of times the respective part of the website was accessed by the intern), on the homepage, tool page, content pages, glossary, target questions, and annotations were recorded for the experimental subjects.

The study used a block design where each university (ISU, KSU, and ECU) served as a block. Each block consisted of control and experimental groups. The ISU experimental group consisted of 2 classes; therefore, class was nested within the group and university in the analyses. Figure 6 is a graphical depiction of the study design.

Statistical analysis was conducted using SPSS for windows version 9.0. Frequencies, descriptive statistics, and histograms were run to examine the distribution of the data. The

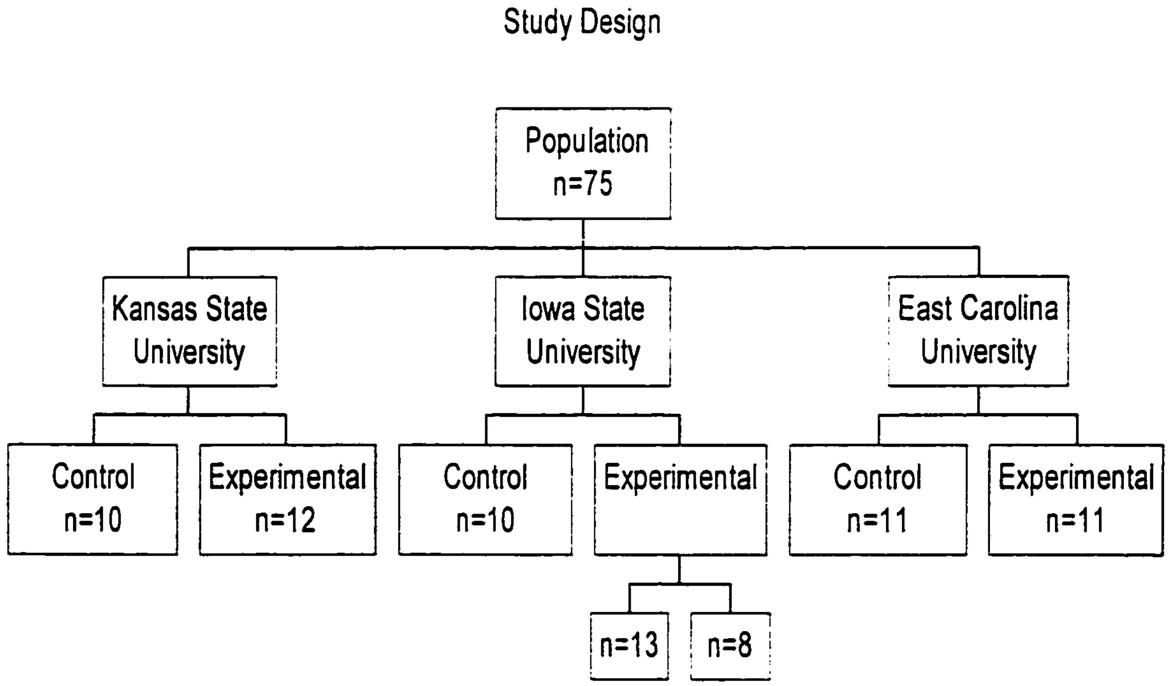


Figure 6. Study Design.

data appeared to be sufficiently normal distributed, thus ANOVA and regression analyses were appropriate. The procedure UNIANOVA was used to conduct the ANOVA and linear regression analyses. ANOVA (see Appendix E), was used to examine the change in computer attitude scores and performance on the RD exam between the control and experimental groups taking into account the university and class. Linear regression (see Appendix F), was used to examine the predictive value of demographic variables, learning styles, and module use on change in computer attitudes and RD exam performance taking into account the university and class. The level of significance used for the analyses was .05. Means, β values, standard errors, confidence intervals, and p values were reported.

CHAPTER 4. IMPROVING DIETETIC EDUCATION WITH INTERACTIVE COMMUNICATION TECHNOLOGY

A paper published in the Journal of the American Dietetic Association[1]

Ruth E. Litchfield[2], Mary Jane Oakland[3], and Jean A. Anderson[4]

Abstract

Changes occurring in healthcare, education and technology are bringing changes to dietetic education. A model of learner-centered, cooperative distance education using interactive online technology for use in a dietetic internship is described. Evaluation of this model includes 'key-feature' exams, survey of computer attitudes, use of the technology by interns, exit interviews, and registered dietitian (RD) exam scores. A pilot study (N=8) of this model indicates that attitude and comfort with using the internet are improved significantly with this educational model. The findings indicate that the use of interactive communication technology in dietetic education has the potential to improve competency, technological aptitude, professional partnering skills and lifelong learning skills.

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[1]Reprinted with permission of the Journal of the American Dietetic Association, 2000, 100(10), 1191-1194.

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Introduction

The millenium brings a multitude of changes in healthcare, education and technology. Each of these factors has precipitated change in dietetic education. Health care and public health have experienced significant 'right-sizing' among many facilities and programs. This trend has decreased the number and geographic location of preceptors and facilities available for dietetic internships and other healthcare training programs. A change in student demographics over the past ten years has led to an influx of geographically bound, adult learners returning for a second degree or additional certification for career advancement. Significant changes have occurred in electronic communication technologies; the rate of computer ownership has increased 4-5 fold and internet access has grown eight-fold during the past 10-15 years (1). This paper describes how communication technology can deliver dietetic education and training to more non-traditional, diverse and geographically dispersed students and precepting facilities. It also permits dietetic education and practice to reach underserved populations in rural communities.

Learner-centered Cooperative Learning

Contemporary students view knowledge and derive meaning in a vastly different style than the teaching traditionally employed in higher education. In the past, the traditional lecture system focused on coverage of material through teaching by telling. However, this approach does not fit the preferred learning style for the majority of today's students. Approximately 75% of the general population have been estimated to prefer the sensing learning pattern with concrete, practical, and immediate learning experiences (2). Recently, Hagan and Taylor (3) reported that in a sample of 84 dietetic interns given the Myers Briggs Type Indicator (MBTI) over half (53%) were the sensing/judging (SJ) temperament. Sensing learners and SJ temperaments prefer concrete, practical and immediate learning experiences (4). Learning strategies that work well for these learners are group discussions, case studies, case study presentations and field experiences. The dietetic internship, which is designed to facilitate the transfer of knowledge to practice, actively engages the interns' senses in the subject matter with 'hands on' or practical experiences and is highly effective with these learners.

Sensing learning can be enhanced with cooperative learning strategies (5) which emphasize the cooperation and collaboration among students and instructors through teamwork. It provides a useful means for developing transferable skills in solving concrete, practical problems: students learn how to seek out information, work collaboratively, define problems; design solutions, write and communicate effectively and grapple with intellectual agreement (6). Collaboration, including the sharing of resources and experiences, is particularly beneficial in the dietetic internship at Iowa State University (ISU) where the use of many preceptor sites exposes each intern to experiences unique to their site. Sharing these experiences with the other interns via learner-centered, cooperative strategies broadens the scope of the internship experience beyond the confines of the individual preceptor site for each intern. The ultimate goal of the dietetic internship is to foster the development of higher-order cognitive skills which facilitate the transfer of knowledge to practice, critical thinking, problem solving, and lifelong learning. These skills are acquired in learner-centered education.

The dietetic internship trains future nutrition educators and counselors whose responsibility is to facilitate behavior change. Nutrition education may be defined as teaching validated, correct nutrition knowledge to the public in ways that promote the development and maintenance of positive attitudes toward, and actual behavioral habits of, eating nutritious foods that contribute to the maintenance of personal health, well-being, and productivity (7). Cooperative learning develops the social context and interpersonal interactions needed to help clients modify relevant attitudes and behaviors (7). Knowledge and skills are of no use to the nutrition educator if they cannot be applied in cooperative interaction with other people (6).

Opportunities in Dietetic Education

Distance education has been utilized in many ways in dietetic education; however, this has been predominantly in didactic programs, which are more instructor-centered and include videotape, correspondence, audio-visual conferencing, and online instruction. Transforming traditional course content into a distance education format with a learner-centered focus creates opportunity for unique, innovative approaches to dietetic instruction. A blend of course delivery methods, such as internet chat rooms and bulletin boards, video, audio, interactive simulations, group case study presentations, and site visits, can be used to create the learner-centered environment. On-line or technology instruction should not be the sole source of instruction (8); but if used appropriately, can enhance student-student interaction and student-instructor interaction, group learning and sharing of resources and experiences, which will ultimately lead to greater understanding.

Model of Learner-Centered, Cooperative Distance Education

This dietetic internship has developed a diverse, versatile use of distance education technology that incorporates cooperative learning directed by the intern. WebCT (WebCT version 1.3.1; Peabody, MA) is the groupware software chosen for this project. It provides a general and individual chat rooms, bulletin boards, e-mail and student tracking mechanisms (see Figure 1). Communication tools are imperative to promote cooperative, interactive learning. For example, information on a clinical case study is divided into four separate pieces and each intern receives only one piece of the case study information. The interns are assigned to different chat rooms where they are 'teamed up' with interns from other facilities who have the remaining pieces of information to complete the case study as a team. Peer review is another form of cooperative learning incorporated into this distance education project. An interactive simulation requires the intern to assess a 24-hour recall for nutrition adequacy and suggest modifications to meet estimated nutritional needs. These suggested modifications are posted on the bulletin board for peer review.

Each module consists of content pages including text, graphics, glossary, hyperlinks to other websites, index, audio clips, animations, interactive calculators, video clips and a patient simulation. The video clips and patient simulation are included on a CD-ROM, which the intern accesses from the Web page. A CD-ROM was developed for each module because downloading videos and simulations over the internet tends to be inefficient, of lower quality, and time consuming. The module has a page outlining the activities, expectations and assignments to be completed by the intern; the intern may submit written assignments by mail or e-mail. While the outlined activities and expectations direct the intern toward the desired competency, the actual learning is controlled by the intern. The intern also takes a ten-point pre- and post-quiz as part of the module to measure comprehension.

An interactive simulation is included in each module as a capstone activity. This allows the intern to test his/her ability to transfer knowledge into practice using critical thinking and problem solving skills. Each patient simulation is representative of the content area with information necessary to perform a nutrition assessment and plan appropriate interventions for various situations. The simulation provides feedback on the appropriateness of the intervention chosen by the intern and rationale for the preferred intervention. For example, a hemodialysis patient wishes to eat lunch at a grocery store deli and the intern assists the patient in selecting a menu which would meet the diet prescription from over 50 foods (see Figure 2). The intern receives feedback on the menu selections. These simulations represent true-to-life professional practice situations for the intern.

The overall success of this distance education project will be evaluated and reported in future manuscripts including clinical competency as assessed by 'key-feature exams' (9), results of computer attitude survey, use of distance education technology by interns, exit interviews, and first-time performance on the RD exam. Two other institutions of higher learning with dietetic education programs similar to ISU have been contacted to pilot the on-line modules during the 1999-2000 academic year. This will provide data to determine if this mode of instruction is viable in a variety of settings.

Key feature pre- and post-module exams have been constructed for each of the modules. A key-feature is defined as the critical step in the resolution of a clinical problem, and a key-feature problem consists of a clinical case scenario followed by questions that focus only on those critical steps. It is hypothesized that the 'key-feature exams' may be a better measure of actual transfer of knowledge into practice or competency than the traditional exam system, which merely measures comprehension.

To assess attitudes towards computers and the internet an instrument was adapted from Delcourt and Kinzie (10). This is to determine if attitude toward computer technology influences success with this type of instruction. The instrument consisted of 19 items; 11 items measured perceived usefulness of computers and 8 items measured perceived comfort/anxiety working with computers. The instrument also included a self-efficacy instrument for word processing, e-mail, and CD-ROM databases that was adapted to a 13-item instrument for the World Wide Web. A Likert scale with a 4-point response format was used for both instruments with descriptors ranging from *strongly disagree (1)* to *strongly agree (4)*. It is hypothesized that as interns discover the learning opportunities technology offers they will use it more proficiently; thus, professionally positioning themselves for the future.

The groupware software used in this model (WebCT version 1.3.1; Peabody, MA) includes various student tracking mechanisms which are used to monitor the use of the technology by the interns. These mechanisms include: number of electronic 'hits' on each page, glossary, and target tools; total time spent on each page; pre- and post-quiz scores; and number of bulletins posted.

The spring 1999 dietetic internship class at ISU served as the pilot group for this project. Table 1 presents the group demographics (n=8); median values are reported due to the small sample size. The gender, age, and GPA of the pilot group is similar to that seen in previous classes of interns. This group, however, did have a significant amount of work experience in the field of dietetics prior to the internship experience.

The three modules included 42 computer pages of content which were electronically 'hit' 1885 times during an eight week span. The interns spent an average of 4 minutes and 40 seconds on each 'hit'; however, the average time spent on a page ranged from 16 seconds to 18 minutes. Students do have the opportunity to print any of the pages of each module

Results of the computer attitude survey and module pre- and post-quizzes indicated a positive attitude toward the use of computers prior to the internship (Table 2); this did not change significantly during the course of the internship. However, the groups' self-efficacy and comfort with the internet improved significantly (P=.010) during the course of the internship. The wide variability of interns'scores on comfort using the internet at pretest was greatly reduced after the experience of using online instruction .

The quizzes in each of the modules included questions developed by practitioners, researchers, adaptation of textbook test banks, and continuing professional education questionnaires in the *Journal of the American Dietetic Association.* The mean scores on these quizzes tended to improve over the course of the internship (Table 2), with the only significant improvement in the renal module (P=.001). Although this was the only quiz score that demonstrated significant improvement after the use of online instruction, this type of evaluation may not be appropriate for dietetic internships and entry-level practitioners. These quizzes evaluate knowledge base rather than professional competence, therefore a more appropriate evaluation for dietetic internships and entry-level practitioners may be the 'key-feature' exams.

Applications

This project demonstrated that, given the opportunity, dietetic interns will utilize on-line instruction. Although interns have an appreciation for the role of computer technology in the profession, their comfort level can be improved with on-line instruction during the dietetic internship. This project demonstrated a significant improvement in comfort using the internet; overall comfort with computers may be significant with a larger sample size. Exit interviews conducted with the pilot group have been very positive and favorable towards the use of on-line instruction in this dietetic internship program. The use of 'key-feature' exams to evaluate competency and the use of on-line instruction and RD exam performance are key outcomes to be examined in future manuscripts as this project continues.

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TABLE 1. Demographics of pilot group (n=8)

Intern Characteristics	**Descriptive Statistics**
Sex	
Female (n=7)	88%
Male (n=1)	12%
Age (median years)	23
Overall GPA (median)	3.2
Science Coursework GPA (median)	2.7
DPD Coursework GPA (median)	3.5
DPD Program	
ISU (n=4)	50%
Non-ISU (n=4)	50%
Amount of Work Experience	
<160 hours	0%
160-480 hours (n=1)	12%
480-960 hours (n=3)	38%
>960 hours (n=4)	50%

Table 1. (continued)

Type of Work Experience[a]	
1 area of dietetics (n=2)	25%
2 areas of dietetics (n=4)	50%
3 areas of dietetics (n=2)	25%

[a]Areas of dietetics include: community, foodservice management, medical nutrition therapy

TABLE 2. Paired t-test results of survey and quizzes (n=8)

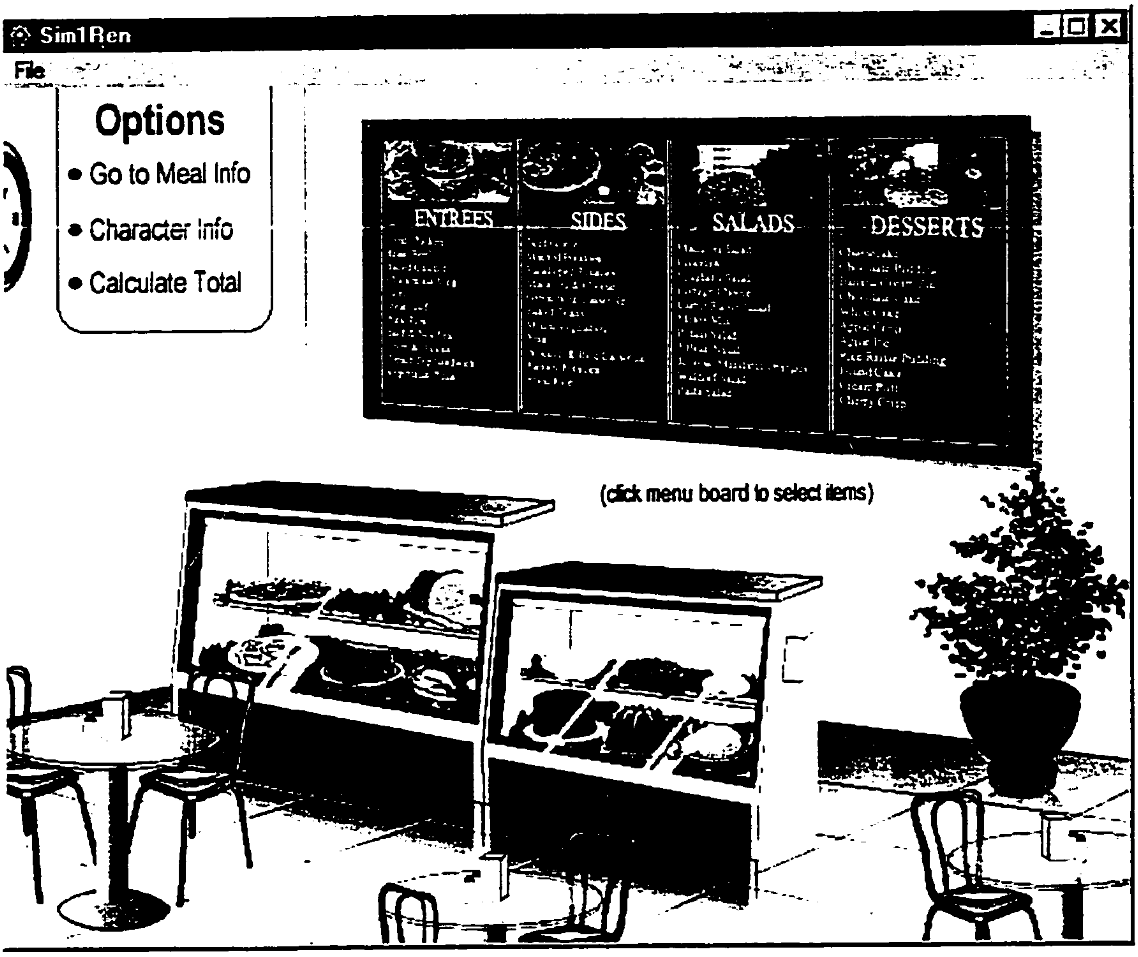
Survey Item / Quiz	Pretest Mean ± SD[a]	Posttest Mean ± SD	Difference (95% CI)[b]	P value
Computer Survey[c]				
Computer Attitude	47.8 ± 2.5	50.0 ± 3.0	2.2 (-0.2, 4.7)	.069
Computer usefulness	26.4 ± 2.0	27.3 ± 1.9	0.9 (-1.3, 3.1)	.371
Comfort w/computers	21.4 ± 1.3	22.8 ± 2.4	1.4 (-0.7, 3.5)	.164
Comfort w/internet	40.0 ± 10.0	51.3 ± 1.5	11.3 (3.6, 18.9)	.010**
Quiz scores (maximum score = 10)				
Nutrition Support	6.2 ± 1.8	6.5 ± 1.8	0.3 (-1.1, 1.7)	.617
Pediatrics	6.9 ± 0.9	7.0 ± 1.5	0.1 (-1.1, 1.4)	.788
Renal	5.8 ± 1.1	7.4 ± 1.0	1.6 (0.9, 2.3)	.001***

[a]SD = Standard deviation.
[b]CI = Confidence interval.
[c]Higher scores reflect more positive attitude toward computers including perceived usefulness, comfort with computers, and ability to use the internet.
**P<.01
***P<.001

Figure 1. Communication technology terminology.

Groupware software	Software providing the infrastructure to develop and deliver online instruction. Software packages generally provide the structure to store/retrieve html files, audio files, graphic files and communication tools such as chat, bulletin board, and e-mail.
Chat room	A method of synchronous communication analogous to an online conference call where conversation occurs via messages typed. Everyone currently logged in to a chat room can read the messages being posted. Like a conference call on the telephone, you are only aware of the conversation from the time you join the chat session. Some educational software allows for logging of chat room conversations by the instructor. Good for brainstorming, online office hours, tech questions, etc....
Bulletin board	A method of asynchronous conversation where messages are typed and posted to an area that allows for others to read the message at a later time. Most bulletin boards can be divided into discrete forums for conversations of specific topics or by specific individuals. Useful for group work. Useful for exchanging longer, more thought out commentaries.
E-mail	Electronic mail, method of sending electronic information from one person to specifically designated people. Can usually attach electronic files to the e-mail message, which is itself plain ascii text.
Hyperlink	A method of connecting electronically stored information. When a hyperlink is activated (i.e., selected or clicked upon), the information to which it points is displayed. The information retrieved can be of many different forms, including a text or HTML document, an image, an audio file or some type of simulation program.

Figure 2. Grocery store deli in the renal simulation.



CHAPTER 5. ONLINE INSTRUCTION IN A PRE-PROFESSIONAL TRAINING PROGRAM: STUDENT CHARACTERISTICS INFLUENCING USE AND PERFORMANCE

A paper submitted to The Internet and Higher Education

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Abstract

Changes in healthcare and educational technology initiated the inclusion of interactive online technology in this pre-professional training program. Scrollable text, graphics, audio clips, animations, interactive calculators, video clips, and simulations were included in the program. Cooperative learning strategies were incorporated into the online instruction to initiate learner/instructor and learner/learner interaction. Seventy-five dietetic interns from three universities (Iowa State University, Kansas State University, and East Carolina University) served as subjects for the study. Students from each university were randomly assigned to groups with and without online instructional support. Use of the online instruction and computer attitudes was examined. Demographic variables and previous computer experience did not influence the use of the online instruction. However, those that reported preferring to work with others used the online instruction more. Significant improvement in self-efficacy with the World Wide Web occurred irrespective of the treatment. It appears that online instruction can appeal to a wide variety of students.

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Introduction

"Distance education fits into the evolution of education at the millenium" (Connick, 1999) and is encompassing a larger role in the traditional higher education model. The influx of adult lifelong learners has increased full-time enrollment in distance education over the past 10 years (Wallace, 1996). It was recently reported that 30-40% of all students at the post-secondary level were pursuing education for a career change (Chambers et al., 1996). Many times, these adult learners are frequently geographically bound, which prevents them from pursuing further education in the traditional campus classroom setting. Thus, the number of students enrolled in distance education between 1995 and 1998 doubled (754,000 to 1,632,000) and represented 10.5% of the total enrollment in higher education (U.S. Department of Education, National Center for Education Statistics, 1999). Much of this growth was due to rapid advances and accessibility in information technology. Computer ownership has increased 4-5 fold and internet access has grown eight-fold during the past 10-15 years (United States Department of Commerce – National Telecommunications and Information Administration, 1999). Acquiring the skills to use this technology is critical not only to pursue educational opportunities, but also to function more effectively in future professional roles.

Today's students prefer a learning style other than the lecture system, which is traditionally employed in higher education. It has been estimated that 75% of the general population prefers concrete, practical and immediate learning experiences (Wennick, 1999), or sensing learning. Cooperative learning is an instructional strategy that works well with sensing learners and is characterized by cooperation and collaboration among students and instructors to enhance the learning experience (Johnson et al., 1991). This teaching strategy can be incorporated into a distance education format using state-of-the-art information technology. These trends in technology and student demographics have presented higher education with significant challenges for the new millenium.

Distance Education

The Internet and World Wide Web (referred to as online technology) contributed significantly to growth in distance education over the past 10 years. Worldwide there are more than 17,000 courses available entirely online and the online learning market is estimated to grow to $8.3 billion by 2002 (Schoefield, 1999). Approximately 2.2 million (15%) of all post-secondary students will be enrolled in online courses by 2002 in the United States alone compared with 5% in 1998 (Schoefield, 1999). The percentage of institutions offering online courses using asynchronous (not in real time) technology increased from 22% to 60% between 1995 and 1998; during this same time the number of distance education courses, degrees and certificate programs nearly doubled (U.S. Department of Education, National Center for Education Statistics, 1999). The majority of online coursework tends to be undergraduate level offerings rather than graduate or professional training; however, health professions are the most prevalent certificate programs offered (U.S. Department of Education, National Center for Education Statistics, 1999).

Newer technologies have expanded the possibilities and offer collaborative opportunities for distance educators to enhance and expand interaction and communication for the distance education learner (Bull, et al., 1999; Kearsley, 2000). One of the most significant ways of engaging the distance learner is to establish minimal levels of participation which require the students to make use of the communication tools available (WebCT, 2000). The isolated distance education student can be brought into a community of communicating peers through the use of online e-mail, bulletin boards, chat rooms, and shared workspaces (Goldberg, 1997; Ridenour, 1998). Current technology also supports interactive, graphical computer simulations, which engages students in repeated experimentation and practice (Goldberg, 1997). Simulations apply mastery learning (Bahrick, 1984) and problem-based learning (Dreyfus & Dreyfus, 1986; Goldberg, 1997), which result in improved performance as a result of practice.

An educational theory developed specifically in the context of online technology is the 'engagement theory' by Kearsley and Shneiderman (1998). Students who actively engage in learning experiences tend to learn and retain more over time; thus, online instruction which requires students to interact with information because the instructor isn't present may result in a greater depth of learning and retention (Hanson et al., 1998). According to this theory, engagement includes designing, planning, problem solving, evaluating, decision-making, or discussion. Problem-based learning is very compatible with online education because access to resources and expertise is a key aspect of problem solving (Kearsley, 2000), yet it has rarely been used in health care training using online technology. Problem-based instruction also initiates critical thinking, which according to Gunawardena (1992) is a key component to successful distance education. Ultimately this theory suggests that online learners must be actively engaged and the learning should be collaborative, problem-based, and authentic – the axioms of cooperative learning.

Cooperative Learning

Cooperative learning is an instructional strategy, which provides the framework to actively engage the learner in the learning process. It also facilitates the development of higher cognitive skills using learner/instructor and learner/learner interaction to achieve critical thinking skills such as analysis, synthesis, and evaluation. "Cooperative learning is indicated whenever the learning goals are highly important, mastery and retention is important, the task is complex or conceptual, problem solving is desired, divergent thinking or creativity is desired, quality of performance is expected and higher level reasoning strategies and critical thinking are needed," (Johnson et al., 1991; pp. 2:13-14).

Historically, higher education has placed students in a competitive and individualistic environment. However, management philosophies in business and industry predict that team-based work is needed for success in the future (Cavalier et al., 1995). Employers need employees who can communicate effectively, work productively with others, and integrate knowledge with problem solving.

Cooperative learning is a group learning process built on the belief that students learn better when they learn together. It is a structured, systematic instructional strategy in which small groups work together toward a common goal. Students work together to maximize their own and each other's learning. This empowers students to think and learn for themselves, as well as to teach specific content and ensure active cognitive processing. Research has documented successful use of cooperative learning for students from early elementary through college in a variety of content areas (Johnson et al., 1981; Johnson et al., 1991). Cooperative learning strategies that use a problem solving or investigative focus are more successful in developing higher-level the cognitive skills (Nastasi & Clements, 1991). Computer aided instruction using cooperative learning strategies has been shown to result in positive student motivation and learning (Beckwith, 1993; Dalton et al., 1989; Johnson et al., 1985).

Students learn less from listening or watching, than from active engagement which promotes more holistic teaching and learning. With cooperative learning students actively construct their own knowledge by activating prior knowledge and cognitive structures to modify or create new structures with new information (Johnson et al., 1991). Active learning facilitates abstractness, openness, flexibility and readiness for independent thinking and action (Middlemiss & Van Neste-Kenny, 1994). Cooperative learning provide a useful means for developing transferable skills: students learn how to seek out information, work collaboratively, define problems, design solutions, write and communicate effectively, and grapple with intellectual agreement (Smith, 1986).

Various cooperative learning strategies are supported by online technology and can be used in the online learning community. For example, with groupware software that supports individual chat rooms, the jigsaw technique can be used to create synchronous learning teams within each chat room. The bulletin board can be used to facilitate asynchronous group learning such as peer review; students post work on the bulletin board, which is reviewed and edited by fellow classmates.

A pre-professional health care training program at Iowa State University has responded to these challenges by creating a new instructional paradigm with cooperative learning strategies and state-of-the-art information technology. It was hypothesized that interactive online instruction would improve students' attitudes toward the technology.

Methods

Facilities serving as preceptors in this pre-professional training program were surveyed to identify availability/accessibility of online computers and hardware/software configurations. From the survey, minimum operating requirements were established for the online instruction project.

WebCT (WebCT version 1.3.1; Peabody, MA) was used to develop, structure, deliver and manage components of the curriculum and learning experience. The WebCT student features included electronic mail and bulletin boards, general and individual chat rooms, glossary, indexing, searching, page annotation, external web site links, learning goals, on-line quizzes and the calendar tool. Three modules of the medical nutrition therapy rotations (nutrition support, pediatric nutrition, and renal nutrition) were developed in an online instructional format and their effectiveness evaluated. These modules were chosen due to the complexity of the subject matter and the option of receiving graduate credit. Each module consists of webpages with scrollable text, graphics, audio clips, animations, interactive calculators, video clips, and a patient simulation. Each module's content was reviewed by two expert practitioners and three faculty to ensure appropriateness. The intern takes a timed ten-point pretest prior to completing the module; a timed ten-point posttest follows the completion of the module. The instructor features of WebCT used included student progress tracking, quiz administration and management, student management, access control, and course backup and transfer.

Graphics, animations, interactive calculators, video and simulations were created by the Instructional Technology Center (ITC) at Iowa State University (ISU) by a creative team consisting of the researcher, graphic designer, instructional and media production specialists. The minimum hardware/software requirements, determined by the survey of preceptors, were considered during all phases of the multimedia development. An interactive simulation was included in each module as a capstone activity. The simulation represents a nutrition problem in each of the respective modules and provides feedback on the appropriateness of the intervention chosen by the intern and rationale for the preferred intervention. The video clips and patient simulations are included on a CD-ROM because downloading the videos and simulations over the internet is very timely and inefficient. In addition this information is more stable, thus not requiring constant updates and revisions that some of the information included online does.

The communication tools within WebCT were used to promote cooperative, interactive learning. A clinical case study was divided into four separate pieces and each intern received only one piece of the case study information to create a jigsaw. The intern is responsible for mastering his/her part of the material and then completing the case study with the other interns in the chat room. Peer review is another form of cooperative learning incorporated into this distance education project. The pediatrics module includes an interactive simulation requiring the interns to make recommendations to a 24-hour recall. This is posted on the bulletin board for peer review. Each week the student is also expected to participate in a scheduled chat room, bulletin board assignment, and electronic mail journal.

Evaluation

The Attitudes Toward Computer Technologies (ACT) and Self-Efficacy for Computer Technologies (SCT) developed by Delcourt and Kinzie (1993) was used to assess the computer attitudes and self-efficacy in this study. The survey was conducted prior to and at the completion of the internship in both control and experimental groups. A total of 19 items were used for the attitude instrument, 11 measuring Usefulness and 8 measuring Comfort/Anxiety. A thirteen item self-efficacy instrument for using the world wide web

(WWW) was adapted from the 25 self-efficacy items for word processing, electronic mail, and compact disc. A Likert scale with a 4-point response format was used for the instruments using descriptors ranging from *strongly disagree* (1) to *strongly agree* (4). Higher scores in each of the scales reflect a more positive attitude toward computers including perceived usefulness, comfort with computer, and self-efficacy for the WWW.

The survey administered prior to module use also included questions to determine the subject's familiarity with technology by asking questions such as, "During the past year, in a typical week how much time have you spent using a computer for any reason at home, work or school?" Subjects also were asked to identify, from a list of nine, the ways in which they preferred to learn (i.e. listening to instructor, reading, observing, etc...). These survey items were adapted from the Web Course Student Post-Survey used at Kansas State University (Division of Continuing Education, 1998).

Subjects

Subjects for this study (n=75) were completing the supervised practice component of their preparation to become a Registered Dietitian from three universities (Iowa State University-ISU, Kansas State University-KSU, and East Carolina University-ECU). KSU and ECU were invited to participate in the study because they also use geographically dispersed clinical facilities in the supervised practice programs. Three classes in the DI at ISU participated in the study, one class served as the control group (n=10) and two classes served as experimental groups (n=22). One intern in an experimental group at ISU withdrew from the DI resulting in n=21 for the ISU experimental groups. Two classes in the Coordinated Program (CP) at KSU participated in the study with one class as control group (n=10) and one class as experimental group (n=12). One internship class at ECU (n=22) was divided equally into control and experimental groups. The protocol was reviewed by the Human Subjects Review Board at ISU. Demographic data including age, sex, overall grade point average (GPA), science GPA, didactic coursework GPA, and work experience were obtained from the subjects' DI or CP application form. Results of the computer survey were collected for both the control and experimental groups. The computer attitudes survey tool was identified after the measurements of the control group at ISU was completed, thus only the experimental groups at ISU completed this survey resulting in a total experimental n=44 and control n=21. The number of hits (number of times the respective part of the website was accessed by the intern), on the homepage, tool page, content pages, glossary, target questions, and annotations were recorded for the experimental subjects.

Statistics

Use of the three modules by the experimental group (n=44) was monitored using the student tracking feature of WebCT. The number of 'hits' were recorded for the homepage, content pages, tool page, glossary links, page goals, and annotation tool. Linear regression, customized to account for the nested design of the model, was used to examine the predictive value of demographic variables and learning styles on module use. ANOVA, also customized for the nested design, was used to examine the change in computer attitude scores between the control and experimental groups.

Results

Data analysis was performed using the UNIANOVA procedure in SPSS for Windows (SPSS version 9.0.0; Chicago, IL). Demographics of the groups with and without online instructional support are presented in Table 1. Both groups were similar with respect to sex, age, grade point averages, and previous experience with computer use and WWW courses.

The descriptive statistics of module use are reported in Table 2. Factor analysis was conducted to condense these data into groups, which would represent module use. This analysis with varimax rotation identified two factors: 1. Content pages, homepage, and tool page; and 2. Glossary links and page goals. These factors reflect hits at the 'primary' level (content pages, homepage, and tool page are at the first level) and 'secondary' level (glossary and page goals imbedded within the content pages). The annotation tool was rarely used and did not load on either factor. The number of hits from each component of the two factors was combined for further analyses related to module use.

Demographic factors and previous computer experience were not predictive of primary level or secondary level module use (factors 1 and 2). However, previous enrollment in a WWW course and secondary level module use (glossary links and page goals) did approach statistical significance ($p=.06$).

Interns' reported their preference for nine different learning styles. A regression of the learning styles on primary and secondary level module use (factors 1 and 2) is shown in Table 3. Interns preferring to work with others used the online instruction at the primary level (factor 1) more. Interns that preferred to work with the instructor also tended to use the modules more at the primary level ($p=.08$).

The results of the change in computer attitude (posttest – pre-test) scores in both groups are reported in Table 4. There was no significant change in the overall computer attitude, comfort with computers, and perceived usefulness of computers within or between groups. Interns in both groups significantly improved in self-efficacy of using the WWW as the confidence interval for both groups was positive and did not include zero; however, this was not significantly different between those with and without online instructional support.

All interns were required to report the number of hours per week spent outside the precepting facility to complete the modules. Increased time spent working with the modules predicted improvement in overall computer attitude and comfort with computers as shown in Table 5.

The relationship between demographic factors and change in computer attitudes was examined using a linear regression model. Science GPA predicted change in perceived computer usefulness ($F=5.24$, $p=.03$). Overall GPA approached statistical significance in relationship to change in overall computer attitude and computer usefulness ($p=.08$ and $p=.06$ respectively). Previous enrollment in a WWW course and its relationship with change in self-efficacy with the WWW approached statistical significance ($p=.10$). Primary and secondary level computer use (factors 1 and 2) was not associated with change in computer attitudes.

Discussion

Although there was significant improvement in interns' self-efficacy with the WWW, this occurred irrespective of the use of online instructional support. It is possible that the current 'information-age' environment has a positive effect on interns' self-efficacy with the WWW whether or not it is introduced in a structured manner. There was no significant change in any of the other computer attitudes as a result of the online instruction. In addition, primary and secondary module use (factors 1 and 2), did not influence computer attitudes. However, an 8-week intervention is a short period of time to measure change in an attitude. As expected though, the amount of time spent using the modules was predictive of some attitude changes (overall computer attitude and comfort with computers). The regression of demographic variables on change in computer attitudes does indicate that science GPA and possibly the overall GPA may be predictive of perceived computer usefulness. One could theorize that those who are academically successful would be more conscious of the opportunities technologies offer.

Key considerations in evaluating the effectiveness of new instructional strategies include accessibility to and application of the material. Although computer ownership and accessibility has grown significantly in the past 10 to 15 years, there are segments of the population that remain 'unconnected' (United States Department of Commerce – National Telecommunications and Information Administration, 1999). Thus, accessibility remains a concern for educators to consider. Due to the novelty of online instruction, minimal research has been conducted to determine if online instruction only targets certain student learning styles. It has been reported that learning style, assessed by the Group Embedded Figures Test (GEFT), did not influence achievement in online instruction (Shih, 1998). Yet, this study found learning styles that preferred to work with others and the instructor, tended to use the online instruction more. This finding supports the premise that distance education technology does facilitate cooperative learning strategies that will be used by learners. Conversely, the current study demonstrates that demographic factors, such as age, GPA, and previous computer use did not influence use of online instruction. Thus, it appears that distance education programs, which are technology-based, can appeal to and be used by a broad student base.

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Table 1. Demographics of control and experimental groups

Intern Characteristics	**Controls** **N=31***	**Experimental** **N=44**
Gender Female Male	 96.8% 3.2%	 97.7% 2.3%
Age, years (mean ± SD)	25.7 ± 6.5	24.1 ± 3.5
Overall GPA (mean ± SD)	3.3 ± 0.3	3.3 ± 0.4
Science Coursework GPA (mean ± SD)	2.9 ± 0.5	3.0 ± 0.6
Professional Core Coursework (mean ± SD)	3.4 ± 0.4	3.4 ± 0.4
Computer use (hours/week)		
• >40 hours	0%	5%
• 20-40 hours	14%	14%
• 10-19 hours	43%	41%
• 3-9 hours	29%	36%
• 1-2 hours	14%	2%
• <1 hour	0%	2%
Previous WWW course	48%	36%

*N=21 for Computer use and Previous WWW course

Table 2. Use of the module features by interns using the online instruction (n=44)

Module Feature	**Minimum no. of hits**	**Maximum no. of hits**	**Mean ± SD**
Homepage*	4.0	234.0	71.1 ± 54.9
Content pages*	23.0	330.0	160.0 ± 65.2
Tool page*	10.0	294.0	71.1 ± 63.9
Glossary†	0.0	493.0	89.1 ± 87.9
Page goals†	0.0	39.0	6.8± 10.9
Annotation tool	0.0	22.0	2.3 ± 4.2

*Elements included in factor 1, primary level hits.
†Elements included in factor 2, secondary level hits.

Table 3. Relationship between preferred learning style and use of line instruction (n=44)

Learning Style	**Primary level hits** **β Value** *Standard Error* 95% Confidence Interval *P value*	**Secondary level hits** **β Value** *Standard Error* 95% Confidence Interval *P value*
Listening to information	**44.6** *40.4* (-37.8, 126.9) *.28*	**-18.4** *43.6* (-107.4, 70.5) *.68*
Reading text	**28.0** *29.9* (-33.0, 89.1) *.36*	**-28.3** *32.3* (-94.2, 37.7) *.39*
Writing own notes	**-52.0** *36.6* (-126.7, 22.7) *.17*	**-35.9** *39.6* (-116.5, 44.8) *.37*
Observing or trying	**55.4** *68.8* (-84.9, 195.7) *.43*	**15.0** *74.3* (-136.6. 166.6) *.84*
Working on own	**33.9** *32.1* (-31.5, 99.2) *.30*	**43.3** *34.6* (-27.4, 113.9) *.22*
Working with others	**71.8** *34.5* (1.5, 142.1) *.05**	**-20.0** *37.3* (-96.0, 56.0) *.60*

Table 3. (continued)

Working with instructor	**-61.1** *33.3* (-129.0, 6.8) *.08*	**-41.3** *36.0* (-114.6, 32.1) *.26*
Structured due dates	**67.0** *40.0* (-14.6, 148.5) *.10*	**31.8** *43.2* (-56.3, 119.8) *.47*
Working at own speed	**38.1** *32.1* (-27.3, 103.6) *.24*	**46.0** *34.7* (-24.7, 116.7) *.19*

*Significant at the p<.05 level.

Table 4. Comparison of change in post and pretest scores in computer attitudes between interns with and without online instruction

Computer Attitude Score	Mean *Standard Error* 95% Confidence Interval		F value	P Value
	Without online instruction n=21	With online instruction n=44		
Computer Attitude	**-0.4** *0.8* (-1.9, 1.2)	**0.8** *0.6* (-0.3, 1.9)	0.04	.87
Comfort w/computers	**-0.4** *0.5* (-1.4, 0.6)	**0.1** *0.4* (-0.7, 0.8)	0.00	.98
Usefulness of computers	0.0 *0.6* (-1.1, 1.1)	**0.7** *0.4* (0.0, 1.5)	0.04	.87
Web self-efficacy	**3.4** *1.6* (0.2, 6.5)	**9.5** *1.1* (7.3, 11.7)	28.88	.11

Table 5. Relationship between hours of module use and change in computer attitudes (n=44)

Computer Attitudes	**β Value** *Standard Error*	**95% Confidence Interval** *p Value*
Overall Computer Attitude	**0.2*** *0.7*	**(0.0, 0.3)** *.02*
Comfort with Computers	**0.1*** *0.0*	**(0.0, 0.2)** *.03*
Usefulness of Computers	**0.1** *0.1*	**(0.0, 0.2)** *.24*
Self-efficacy w/WWW	**0.1** *0.1*	**(-0.2, 0.3)** *.60*

*Significant at the p<.05 level.

CHAPTER 6. CLINICAL COMPETENCY: WHAT IS IT? CAN IT BE TAUGHT? CAN IT BE EVALUATED?

A paper to be submitted to The Journal of the American Dietetic Association

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Abstract

Objectives To evaluate if interactive online instruction improves intern performance and examine key-feature exams as a tool to evaluate clinical judgment and competency.

Methods Three modules of interactive online instruction were incorporated into the supervised experience component of three dietetics education programs. Two key feature exams were developed for each of the modules to serve as pre- and post-tests.

Subjects/Intervention Seventy-five dietetic interns/coordinated program students at Iowa State University, Kansas State University and East Carolina University were randomly assigned to control (without online instruction) or experimental (with online instruction) between January 1999 and May 2000.

Main outcome measures Intern performance was evaluated using first time scores from the national RD exam and change in scores on the key features exams.

Statistical analyses performed ANOVA, customized to account for the experimental error introduced by the nested design of the model, was used to analyze key feature exam and

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RD exam scores between the control and experimental groups. Linear regression, also customized for the nested design, was used to examine the predictive value of: module use on key feature exam and RD exam scores; demographic variables on key feature exam and RD exam scores; key feature exam scores on RD exam scores; and preferred learning styles on key feature exam and RD exam scores.

Results Interns using the interactive online instruction significantly improved in performance on the nutrition support key feature exam (p=.01) compared with interns not receiving the online instructional support. Intern performance on the pediatric key feature exam was significantly different between the control and experimental groups (p=.03) as the experimental group did not experience the decline that the control group did. There was no statistical difference in the two groups' performance on the RD exam. Key feature exams accommodate a greater variety of learning styles than the RD exam.

Applications/Conclusions Interactive online technology can be successfully incorporated in the dietetics experience program to enhance the experiential learning process and increase performance in the areas of pediatric nutrition and nutrition support. The impact of this online instruction on performance, and competency, warrants further investigation. An alternative format to the traditional RD exam, such as the key feature exam, may be needed to evaluate competency rather than knowledge.

Introduction

Dietetics educators are challenged by contemporary and projected trends in health care to prepare future professionals. Decreased length of hospital stay, increased use of home care and community health agencies, and the emergence of managed care are changing roles and expectations. Thus, training entry-level practitioners requires stimulating higher-level thinking in non-traditional settings, such as community-based health care. The constantly changing environment necessitates that entry-level practitioners be equipped with knowledge and problem-solving skills that are competent and high quality (1). The American Dietetic Association (2) drafted competencies to address the changing roles of the dietitian and make new graduates prepared for a competitive marketplace. The competencies are broad, functional statements of the skills, supporting knowledge, and professional values to be provided in the supervised practice to begin independent professional practice (3). Dietetic educators must explore innovative ways to achieve these competencies while training students for future roles and responsibilities (4).

Experiential Learning and Skill Development in Dietetic Education

Puckett (5) recently reported from an informal interview with dietetics practitioners, students, educators, administrators and leaders in foodservice industry (N=33), that dietetics course work did not prepare practitioners to meet today's challenges. She recommended that educators seek methods for gaining practical experience to enhance the formal education process. Dietetics educators tend to underestimate the need for on-the-job training, or experiential learning (6).

Experiential learning occurs during dietetics experience programs where the beginner develops competency by learning how to apply textbook knowledge and demonstrated laboratory skills (6). This learning integrates two different kinds of knowledge, concepts/principles and actions/skills; teaching them together acknowledges that they work cooperatively to achieve professional competency (7). Using real tasks in training, such as the Dietetic Internship, is the preferred method of instruction to help students link specific content knowledge and strategic action. This linkage is critical in the development of higher cognitive skills such as problem-solving and decision-making, which are particularly important to professions such as medicine (8). Gates et al. (9) demonstrated that clinical reasoning skills were developed during the supervised practice as the learner integrates knowledge and skills with caring for patients. Although role playing, case studies, and similar simulations of professional practice are commonly used, field experiences in which students are placed in the community for firsthand observation and application are more beneficial (10). Educational strategies with active participation by the learner develop research, counseling, and education skills that are essential to the competency of dietetics professionals (11).

The ability to communicate and collaborate is also necessary for the competent, entry-level practitioner (2). Kirk et al. (12) surveyed 300 dietitians from the Dietitians in Business and Industry practice group of ADA and 300 prospective and current employers of Registered Dietitians (RD) and found that communication skills were the most desired attribute reported by both groups. While the assumption has been made that dietetic education programs provide students with these skills (2), they continue developing during the dietetics experience program.

Competence in Dietetic Education

The attainment of competency, and competency-based dietetics education is consistent with the Dreyfus and Dreyfus (13) novice-to-expert literature (6). In the novice-to-expert continuum Chambers et al., (14) and Oakland (15) propose that graduates of dietetics experience programs attain the competent stage.

The competent practitioner has a goal in mind and sees a situation as a set of facts, which are prioritized, a decision is made, and action is carried out (13,16). Competency is the ability to cope and manage many contingencies realizing there are no steadfast objective rules. Competent practitioners view their decisions and actions in terms of long range consequences, whereas the novice and beginner can only apply the rule to the present situation (17). Duch (18) has summarized competency as the ability to:

1. Think critically and analyze and solve complex, real-world problems.
2. Find, evaluate and use appropriate learning resources.
3. Work cooperatively in teams and small groups.
4. Demonstrate effective oral and written communication skills.
5. Use content knowledge and intellectual skills to become continual learners.

Dietetics education and experience programs are the initial contributors to entry-level competence in dietetics professionals (19). Indicators of competency include students' standardized test scores, grade point averages, attainment of course objectives, performance on licensure exams, and job placement (20). One of the strongest indicators of competence is outcome-oriented performance measures (19) of clinical judgment. Outcome oriented measures typically address one of two goals--performance of clinicians compared to that prescribed by a statistical model or actual thought processes used by clinicians in diagnosis and intervention (21). However, little is known about how to measure a practitioner's ability to recognize and look for problems, and there are limited measures of clinical performance that are valid and reliable. Evaluation of clinical judgment is difficult since objective measures do not adequately recognize expertise in performance evaluation, rather interpretative and qualitative measures are needed (17, 22). Evaluation for competency should include more simulations and authentic evaluation, i.e. case studies, clinical scenarios, and patient care vignettes (23) – tasks one would be expected to perform in real work settings (14).

Bordage and Allen (24) have proposed the 'key-feature' exam as a means to evaluate clinical reasoning and competence in a pencil and paper format. They developed this type of examination in response to the finding that most diagnostic errors (57%) can be attributed to cue misintrepretation rather than knowledge deficiencies. Page and Bordage (25) propose that clinical judgment is contingent on the effective manipulation of a few elements of the problem that are crucial to its successful resolution – the problem's 'key features'. A key-feature is defined as the critical step in the resolution of a clinical problem, it is the step where most errors are likely and it is a difficult aspect in the identification and management of the problem. The key-feature problem consists of a clinical case scenario followed by questions that focus only on those critical steps (26). The key feature exam evaluates the ability to use knowledge in solving problems and on the processes involved in the resolution of the problem, such as cue interpretation to diagnose or acquire additional data. The shorter length of the examination facilitates testing a greater number of specific cases and problems necessary for evaluating clinical judgment.

Presently the American Dietetic Association assesses RD competency with the national RD exam. The history of Iowa State University's Dietetic Internship first-time pass rate on the national RD exam is shown in Figure 1. In 1996 interns were at supervised practice sites geographically located within 50 miles of the university without online support and the RD exam was administered in a paper and pencil format. The January 1997 – June 1998 interns were geographically dispersed across the state without online support and the RD exam remained paper and pencil format. The June – December 1998 interns were geographically dispersed, supported with online communications only, and the RD exam became computerized. From January – December 1999 the interns were geographically dispersed, received online instructional support and the RD exam remained computerized. Although not statistically significant, there was concern that the geographical dispersal that occurred between January 1997 and June 1998 had compromised intern success on the RD exam. The advent of online communications in June 1998 was timely as the RD exam became computerized.

Nutrition Diagnosis in Dietetic Education

The recent emphasis in quality assurance systems in health care delivery focuses on the use of patient outcomes (27). The Institute of Medicine committee recommended consistency in naming and describing findings, clinical problems, procedures and treatments (28), to facilitate the tracking of patient outcomes. Currently, the dietetics profession does not have a common language to effectively track and document patient outcomes for specific nutrition problems and interventions. Beisemeier and Chima (29) surveyed 500 RDs from three practice groups of ADA (Dietitians in Nutrition Support, Dietitians in General Clinical Practice, and Clinical Nutrition Management) with a high percentage of clinical practitioners. Their results reveal that 93% of dietitians surveyed favor standardized nutrition diagnosis. Diagnostic focus would provide classification system for monitoring activities, resources, and impact on patient outcomes unique to dietetics (30). Kight (31) has proposed Dietetic-Specific Nutritional Diagnostic Codes (D-S NDCs) which would allow greater utilization of the special training of the dietitian, improve patient outcomes, provide potential reimbursement for services in the diagnosis related group setting, and interface with Diagnosis Related Groups (DRGs).

Oakland (15) proposes that the D-S NDC's are a tool to reach higher levels of cognition in dietetics education because it represents clinical judgment. D-S NDC's position

RDs to function at a higher level of practice such as the diagnosis and research oriented activity described in an acculturation model by Kight (32). This level of activity is analogous to the 'expertise' stage of the skill acquisition model by Dreyfus and Dreyfus (13). Unfortunately, much of current dietetic practice does not occur at this level; Thomson et al. (33) observed that these professional activities, such as conferring with physicians, participating on patient care teams and attending medical/surgical rounds, had decreased between 1982 and 1986. Thus, dietetics educators need to introduce concepts such as the D-S NDC's to the entry-level practitioner to cultivate higher level practice in the profession.

Diagnosis is an important clinical judgment that reflects competency and ultimately the quality of health care (34). Therefore, the ability to appropriately diagnose nutrition problems, using the D-S NDCs, could evaluate competency as well.

Technology in Dietetic Education

Technology has increased the speed of change and innovation which is forcing change in professional dietetics practice and education (35). To maximize effectiveness, dietetics educators must be aware of new multi-media technology opportunities available. This technology can provide the student with experiential training at many stages of dietetic education and training (36).

Currently, there is minimal use of computerization in dietetics (29). McDonald (37) states that there are few studies looking at the computer skills of registered dietitians and there are no studies investigating the internet skills of the registered dietitian. She claims that registered dietitians are lacking in intermediate to advanced skills, such as e-mail management and effective internet searching. It is interesting, however, that 91% of registered dietitians have access to a personal computer, 74% have access to e-mail, 63%

have access to the internet, and 68% have access to CD ROM technology (38). Gilmore et al. (6) reported that computer communication was one of the ADA competencies (2) and Standards of Professional Practice (39) for entry-level dietitians least likely to be taught in educational programs. It is critical that dietitians develop and use these skills to survive in today's technological 'information age.'

Technology has made information more accessible, creating an increasingly informed and educated clientele. This brings increasingly greater expectations and decreased tolerance for ambiguity in the information provided by health care professionals (40). Competence in health care professions depends on information literacy (41) and professionals must embrace technology to keep one step ahead of the customers, patients, and students. Retrieval of health-related information is the second most popular category on the World Wide Web and diet and nutrition information, the second most popular subcategory, makes up 36% of health-related searches (42). There are more than 15,000 health websites with nutrition and disease-related information (43); however, Sutherland (44) claims that numerous websites contain inaccurate or outdated information. In addition to the skill to access and network, an entry-level practitioner must evaluate, interpret, and synthesize the information to use it creatively and effectively. Thus, dietetics educators must teach students to critically evaluate World Wide Web sources (45).

The incorporation of educational technology into biomedical curricula from 1995 to 1996 rose from 47% to 50%; within the health sciences curricula it rose from 33% to 40% (46). Various modes of communication technology have been used to deliver nursing education at a distance (47,48,49) and it appears that these distance education students perform at the same level or better than those in the traditional classroom setting (50, 51).

Technology in dietetic education remains limited, although it has recently grown. Distance education is a component of 23% of all dietetics programs (52), but only three experience programs (two dietetic internships and one AP4) are considered distance education format by the ADA (53).

Computer aided instruction is an efficient and effective method for teaching nutrition competencies to health professionals including dietetics students (54, 55, 56, 57). Strauss and Dahlhemier (58) reported significant improvement in post test scores after implementing multimedia technology (color, sound, and motion using computerized multimedia images, animations, and the internet) into a course covering gastrointestinal anatomy and physiology. Turner et al. (59) reported that dietetics interns using computer-based simulations exhibited a faster rate of skill development, but not skill improvement. Evers et al. (60) found that using computer-based simulations to provide feedback and describing actions of experienced dietitians in simulations was an effective way to foster appropriate assessment and care planning strategies. Plaisted et al. (36) also found improved student learning and retention in students using a CD ROM module on nutrition and cancer in an introductory medical nutrition course. Thus, Wooley and Costello's (61) belief that computer simulations encourage greater emphasis on competence and clinical judgment appears justified.

Methods and Subjects

The interactive online instruction used in this project has been described previously (62). Subjects for this study (n=75) were completing the supervised experience component of their preparation to become a RD from three universities (Iowa State University-ISU, Kansas State University-KSU, and East Carolina University-ECU). KSU and ECU were invited to participate in the study because they also use geographically dispersed clinical facilities in the supervised practice program. Three classes in the Dietetic Internship at ISU participated in the study, one class served as the control group (n=10) and two classes served as experimental groups (n=22). One intern in an experimental group at ISU withdrew resulting in n=21 for the ISU experimental groups. Two classes in the Coordinated Program at KSU participated in the study with one class as control group (n=10) and one class as experimental group (n=12). One internship class at ECU (n=22) was divided equally into control and experimental groups. Protocols in accordance with the Human Subjects Review Board at ISU were followed throughout the study. Demographic data including age, sex, overall grade point average (GPA), science coursework GPA, didactic coursework GPA, and previous work experiences were obtained from the subjects' Dietetic Internship or Coordinated Program application form. The number of hits (number of times the respective part of the website was accessed by the intern), on the homepage, tool page, content pages, glossary, target questions, and annotations was recorded for the experimental subjects. Interns also indicated their preferred style of learning from a list of nine. The survey tool, including preferred styles of learning, was identified after the measurements of the control group at ISU was completed, therefore n=21 for the control group in results on preferred learning styles.

Key Feature Exams

Two key feature exams were developed for each of three online modules (nutrition support, pediatric nutrition, and renal nutrition) to serve as pre- and post-tests of clinical judgment for both control and experimental subjects. The key feature exams were developed according to the protocol outlined by Page et al. (26). Two expert practitioners from each content area assisted with the development of the key feature exams. Each practitioner identified two domains, or nutrition problems, within their area of expertise that an entry-level dietitian would be expected to recognize and manage competently. A clinical scenario was developed using a typical presentation of the nutrition problem identified by the practitioners. For each nutrition problem, 3-4 key features were identified that an entry-level practitioner should recognize to identify the nutrition problem and proceed with the appropriate intervention. In addition, 3-4 D-S NDCs were identified for each problem. A sample key feature exam is shown in Figure 2. A pre- and post-test for nutrition support calculations was also developed. The key feature and nutrition support calculations exams were scored on the percent of correct responses.

Results

Data analysis was performed using SPSS for Windows (SPSS version 9.0.0; Chicago, IL). Demographics of both groups are presented in Table 1 and were similar with respect to gender, age, grade point averages, and amount and type of work experience.

ANOVA, customized to account for the nested design of the model, was used to analyze the key feature and nutrition support calculations scores ratio (post test/pretest), and RD exam scores. Table 2 presents the results of these measures of competence. The control experienced a significant improvement on the nutrition support calculations test; however, there was no statistical difference between those with and without the online instruction. Both groups had significant improvement on the nutrition support and pediatrics key feature exams, and those with the online instruction improved significantly more than those without the online instruction. Both groups had significant improvement in performance on the renal nutrition key feature exam; however, there was no significant difference between the two groups. Of the 75 subjects, 47 had taken the RD exam as of 9/30/00, resulting in n=20 for those without online instruction and n=27 for those with online instruction. There were no statistical differences in performance on the RD exam scores between the groups.

Linear regression, also customized for the nested design, was used to examine the predictive value of module use on change in key feature exams and RD exam scores. Two factors, indicative of computer use were identified from factor analysis of the recorded 'hits' in the interactive online technology. Neither factor had a significant relationship to the key feature exams or RD exam scores. The same linear regression model was used to examine the relationship between demographic factors and change in key feature exam scores. There was a significant positive relationship between overall GPA and change in nutrition support calculations score (p=.03). The amount of work experience and change in renal key feature exam score approached significance (p=.06).

Linear regression was also used to examine the relationships among demographic variables and RD exam scores and are presented in Table 3. The lower two categories of work experience (<160 hours and 160-480 hours) were collapsed due to the small n. A significant positive relationship between the dummy variable 1, representing less work experience, and the food and nutrition subscore of the RD exam was observed. The results of the regression between post-test scores of the key feature and nutrition support calculations scores and RD exam scores are shown in Table 4. The post-test score on nutrition support calculations had a significant positive relationship with all three RD scores.

The relationship between preferred styles of learning and performance on RD exam scores and change in key feature exam scores was also evaluated by linear regression. None of the preferred styles of learning had a significant relationship with the RD exam scores; however, there was a positive trend between learning by reading and the RD exam total score (p=.11) and the food and nutrition subscore (p=.11). Table 5 shows the results of the regression of preferred learning styles on change in the key feature and nutrition support calculations scores. A significant negative relationship between learning by writing and change in nutrition support calculations exam was observed. Significant negative relationships between the learning styles working with others, having structured due dates, and working at own speed were observed with the nutrition support key feature exam score. The renal key feature score had a significant negative relationship with reading, and a significant positive relationship with observing/trying. The relationship between working alone and change in performance on the renal key feature exam approached significance (p=.10).

Discussion

The content areas selected for this project were chosen because they tend to be more difficult concepts with wide variability in the experiences due to geographic location in this internship program. It was not surprising that the interactive online technology did not enhance the change in performance on the nutrition support calculations test; rote arithmetic does not require interactive instructional support for success. The significant improvement in performance on the nutrition support and pediatric nutrition key feature exams is important because these are two areas of medical nutrition therapy where limited and variable experiences available for training, which can make training for entry-level competence difficult. The lack of significant difference in the change in performance on the renal nutrition test may be due to the fact that all interns are placed in a renal dialysis unit. Dialysis units maintain rigorous protocols and procedures according to Medicare regulations and the

National Kidney Foundation's Kidney Disease Outcomes Quality Initiatives. These regulations assure more standardized practice, thus experiences for the interns.

The significant positive relationship between less work experience and the food and nutrition subscore of the RD exam was unexpected; more work experience was expected to positively impact all measures of competence. However, the results with the current sample did not support this. The significant positive relationship between the nutrition support calculations post test score and all three components of the RD exam scores is disturbing. This indicates that the RD exam measures rote knowledge, just as the nutrition support calculations test measures rote arithmetic; thus, the RD exam may not be evaluating clinical judgment, and competency. This explains why there was no improvement in the RD exam scores with the interactive online technology nor significant relationship between key feature exam scores and the RD exam in this project; the interactive online instruction and key feature exams were designed to enhance competency rather than rote knowledge.

There were a variety of preferred styles of learning that related significantly to change in key feature exam scores in this study. This indicates that students with multiple learning styles perform well in this profession, probably because the dietetics profession encompasses a broad scope of practice opportunities. The negative relationship between working with others, having structured due dates, and working at own speed with change in the nutrition support key feature exam score may be related to the work environment in this type of dietetic practice. Nutrition support dietitians tend to work in a fast paced, intense environment, requiring more independent learning. Thus, independent learners that don't require structured due dates to motivate learning, and prefer working at a faster pace perform better in this dietetic practice setting. Although there were no significant relationships between the preferred styles of learning and the RD exam scores. reading and the RD exam total score and food and nutrition subscore exhibited a positive trend. The RD exam may be better suited to those who prefer to learn by reading; whereas. the relationships between preferred learning styles and key feature exams indicate they are suited to a variety of learning styles.

Applications

Although the results of this project were sporadic. dietetics educators can use this information to improve dietetics education and experience programs. The findings include:

- Interactive online instructional support can be used to enhance clinical competency. as evaluated by the key feature exam. in select settings of the dietetics experience program.
- Interactive online instructional support and the dietetics experience programs accommodate a variety of learning styles.
- It was previously reported that the use of online technology increased intern comfort with computer technology ($p=.01$). Improving this comfort level is important because technology is permeating all areas of professional practice. and the RD exam is administered in computer format. Dietetics educators should consider using this technology to enhance student comfort for professional practice and the RD exam.
- This study indicates that the RD exam may be evaluating knowledge rather than competency. Further investigation is needed to determine what type of evaluation is desired.

- Key feature exams, which appear to accommodate a greater variety of learning styles, may provide an alternative format to the RD exam in evaluating competency.

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Figure 1. Iowa State University Dietetic Internship first-time RD exam pass rates

Intern Time Frame	**Number Passing/Number Taking Exam** **%**
January – December 1996	14/17 82%
January 1997 – June 1998	20/26 77%
June – December 1998	10/10 100%
January – December 1999	20/21 95%

Figure 2. Sample key feature exam

TC is an 85 y/o male who is 6' tall and weighs 145#. TC presented to the ER with left sided hemiparesis, aphasia and wife reports altered mental status over the past few days. His wife reports that his high blood pressure has not been well controlled with medication and he has a history of constipation. She thinks he has lost weight -he generally weighs 170#; he hasn't been as mobile the past few months so she hasn't weighed him. His labs in the ER were:

albumin	3.1 gm/dL
cholesterol	135 mg/dL
prealbumin	13 mg/dL
triglycerides	165 mg/dL
Na	138 mEq/L
K	4.0 mEq/L
glucose	85 mg/dL

A swallow evaluation was ordered and the Speech Pathology reports extreme risk for aspiration. Upon visiting the patient you find the wife feeding TC a glass of eggnog through a straw, 'his favorite'. TC's Braden score was 10.

1. What one specific concern would you address with TC's wife?

2. What is the most appropriate means to provide adequate nutrition for TC? (Be specific)

3. What parameters would you use to follow the progress of TC?

4. Identify the four most relevant nutrition problems TC exhibits or is at increased risk of developing.[a]

deficit in nutrition education	potential for disease
deficit in nutrition knowledge	altered nutrient function
nutrition misinformation	altered metabolism
inadequate caloric intake	inappropriate feeding route
inadequate feeding route	inappropriate dietary habits
inadequate protein intake	inappropriate food role/food abuse
altered body composition	misuse of nutrient supplement
impaired growth/development	misuse of enteral product
overweight status	misuse of parenteral product
underweight status	misuse of therapeutic diet
undesirable weight change	undesirable food/nutrient interaction
fluid imbalance	altered nutritional biochemistry
electrolyte imbalance	undesirable food/treatment schedule
intolerance to food/nutrient	altered nutrient disposition

[a]List of nutrition diagnoses adapted from Dietetic-Specific Nutritional Diagnostic Codes from Kight (1985).

Table 1. Demographics of groups with and without online instruction

Intern Characteristics	**Without Online Instruction N=31**	**With Online Instruction N=44**
Sex		
Female	96.8%	97.7%
Male	3.2%	2.3%
Age (mean ± SD)	25.7 ± 6.5	24.1 ± 3.5
Overall GPA (mean ± SD)	3.3 ± 0.3	3.3 ± 0.4
Science Coursework GPA (mean ± SD)	2.9 ± 0.5	3.0 ± 0.6
Professional Core Coursework (mean ± SD)	3.4 ± 0.4	3.4 ± 0.4
Work Experience:		
<160 hours	0%	2.3%
160-480 hours	6.5%	6.8%
480-960 hours	29.0%	31.8%
>960 hours	64.5%	59.1%
Type of Work[a] Experience:		
1 area of dietetics	16.1%	22.7%
2 areas of dietetics	58.1%	56.8%
3 areas of dietetics	25.8%	20.5%

[a]Areas of dietetics include: community, foodservice management, medical nutrition therapy

Table 2. ANOVA of the ratio (post test score / pretest score) in key feature exams and RD exam scores between groups

Key Feature and RD Exam Scores	**Mean** *Standard Error* 95% Confidence Interval		F value	P Value
	Without Online Instruction n=31	**With Online Instruction n=44**		
Nutrition Support Calculations	**3.7** *1.3* (1.3, 6.2)	**1.7** *1.1* (-0.4, 3.9)	1.2	.35
Nutrition Support	**1.3** *0.2* (0.9, 1.7)	**1.9** *0.2* (1.6, 2.3)	11.3	.05*
Pediatric Nutrition	**0.9** *0.1* (0.8, 1.0)	**1.1** *0.1* (1.0, 1.2)	61.0	.01*
Renal Nutrition	**1.1** *0.1* (0.8, 1.3)	**1.3** *0.1* (1.0, 1.5)	0.1	.73
RD Exam Total Score[a]	**29.0** *1.1* (26.9, 31.1)	**28.4** *0.9* (26.6, 30.2)	0.4	.55
Food & Nutrition Subscore	**16.3** *0.7* (14.8, 17.8)	**16.1** *0.6* (14.8, 17.3)	0.2	.70
Management Subscore	**17.5** *1.0* (15.4, 19.5)	**16.3** *0.9* (14.6, 18.1)	1.6	.22

[a]RD exam scores control n=20 and experimental n=27
*Significant at the p<.05 level

Table 3. Linear regression between demographic factors and RD exam scores (n=47)

Demographic factors	**β Values** *Standard Error* 95% Confidence Interval *P Value*		
	RD Exam Total Score	**Food and Nutrition Subscore**	**Management Subscore**
Age	**0.2** *0.1* (-0.1.0.4) *.25*	**0.1** *0.1* (-0.1, 0.3) *.29*	**0.2** *0.2* (-0.1, 0.4) *.22*
Overall GPA	**4.2** *3.6* (-3.1, 11.4) *.25*	**2.7** *2.4* (-2.2, 7.7) *.26*	**2.5** *3.5* (-4.6, 9.5) *.48*
Science Coursework GPA	**0.1** *1.8* (-3.5, 3.8) *.94*	**0.5** *1.2* (-2.0, 3.0) *.68*	**0.6** *1.7* (-6.8, 5.1) *.72*
Professional Coursework GPA	**-2.2** *3.0* (-8.4, 3.9) *.46*	**-2.7** *2.0* (-6.9, 1.4) *.19*	**-0.8** *2.9* (-6.8, 5.1) *.78*
Amount of work experience			
Dummy variable category 1	**4.1** *2.2* (-0.3, 8.5) *.07*	**4.5** *1.5* (1.55, 7.5) *.00**	**0.5** *2.1* (-3.7, 4.8) *.81*
Dummy variable category 2	**0.4** *1.5* (-2.7, 3.6) *.78*	**0.6** *1.0* (-1.5, 2.8) .54	**-0.9** *1.5* (-4.0, 2.1) *.55*
Type of work experience			
Dummy variable category 1	**-4.0** *2.2* (-8.5, 0.5) *.08*	**-2.5** *1.5* (-5.6, 0.5) *.10*	**-2.6** *2.1* (-7.0, 1.8) *.23*
Dummy variable category 2	**-1.9** *1.5* (-5.0, 1.2) *.23*	**-1.0** *1.0* (-3.1, 1.1) *.33*	**-2.0** *1.5* (-5.0, 1.0) *.18*

*Significant at p<.05

Table 4. Linear regression between post test scores and RD exam scores (n=47)

Post test scores	**β Value** *Standard Error* 95% Confidence Interval *P Value*		
	RD Exam Total Score	**Food and Nutrition Subscore**	**Management Subscore**
Nutrition Support Calculations	**0.1** *0.0* (0.0, 0.2) *.01**	**0.1** *0.0* (0.0, 0.1) *.05**	**0.1** *0.0* (0.0, 0.2) *.00**
Nutrition Support	**0.0** *0.0* (-0.1, 0.1) *.88*	**0.0** *0.0* (-0.1, 0.0) *.42*	**0.0** *0.0* (-0.1, 0.1) *.81*
Pediatric Nutrition	**0.0** *0.0* (0.0, 0.1) *.34*	**0.0** *0.0* (-0.1, 0.1) *.93*	**0.0** *0.0* (0.0, 0.1) *.23*
Renal Nutrition	**0.0** *0.0* (-0.1, 0.0) *.26*	**0.0** *0.0* (-0.1, 1.6) *.18*	**0.0** *0.0* (-0.1, 0.0) *.46*

*Significant at p<.05.

Table 5. Linear regression model between preferred style of learning and change in key feature exam performance (n=65)

Style of Learning	**β Values** *Standard Error* 95% Confidence Interval *P Values*			
	Nutrition Support Calculations	**Nutrition Support**	**Pediatric Nutrition**	**Renal Nutrition**
Auditory	**11.4** *8.8* (-6.2, 29.1) *.20*	**0.1** *6.6* (-13.2, 13.4) *.99*	**-1.4** *7.3* (-16.0, 13.1) *.84*	**7.6** *7.1* (-6.7, 21.9) *.29*
Reading	**-2.4** *7.0* (-16.6, 11.7) *.73*	**6.5** *5.3* (-4.1, 17.1) *.23*	**-5.6** *5.8* (-17.2, 6.1) *.34*	**-18.5** *5.7* (-29.9, -7.0) *.00**
Writing	**-17.2** *7.7* (-32.6, -1.7) *.03**	**-3.1** *5.8* (-14.7, 8.6) *.60*	**-1.9** *6.4* (-14.6, 10.9) *.77*	**8.0** *6.2* (-4.6, 20.5) *.21*
Observing / trying	**-11.0** *12.8* (-36.6, 14.7) *.40*	**-3.0** *9.6* (-22.3, 16.2) *.75*	**9.2** *10.5* (-12.0, 30.4) *.39*	**24.4** *10.3* (3.6, 45.2) *.02**
Working alone	**3.1** *7.1* (-22.0, 6.7) *.67*	**4.0** *5.3* (-6.7, 14.7) *.45*	**8.6** *5.8* (-3.2, 20.3) *.15*	**-9.6** *5.7* (-21.1, 1.9) *.10*
Working with others	**-7.7** *7.1* (-22.0, 6.7) *.29*	**-11.5** *5.4* (-22.3, -0.7) *.04**	**3.8** *5.9* (-8.0, 15.6) *.52*	**2.6** *5.8* (-9.0, 14.2) *.66*
Work individually w/instructor	**-7.8** *6.9* (-21.6, 6.0) *.26*	**-2.3** *5.2* (-12.7, 8.1) *.66*	**4.9** *5.7* (-6.5, 16.3) *.39*	**6.4** *5.6* (-4.8, 17.5) *.26*

Table 5. (continued)

Structured due dates	**7.3** *9.0* (-10.8, 25.4) *.42*	**-13.5** *6.8* (-27.1, 0.1 *.05**	**3.5** *7.4* (-11.5, 18.4) *.64*	**8.0** *7.3* (-6.7, 22.6) *.28*
Work at own speed	**-4.4** *6.7* (-17.9, 9.1) *.52*	**-11.0** *5.0* (-21.1, -0.8) *.04**	**-2.2** *5.5* (-13.3, 8.9) *.69*	**-4.8** *5.4* (-15.7, 6.1) *.39*

*Significant at the p<.05 level

CHAPTER 7. GENERAL CONCLUSIONS

Overall, intern response to the interactive online instruction was positive. Of the 21 comments related specifically to the use of technology in the internship 19 (90%) were favorable. Comments from the exit interviews held with the Iowa State University interns included:

- This is a great teaching tool. It would be great to have for each rotation.
- Being on the computer was useful and made the learning experience easier.
- Excellent! Wouldn't change a thing. I learned to be able to communicate with my preceptors and classmates effectively. It truly helps with "computer handicapped" people.
- I thought the web-based technology was good. It was easy to keep in touch with other interns and the directors. The modules were a good learning tool.
- Very good – very helpful for both learning & communication.
- A great tool for communication and education.
- Good idea – great way to communicate to each other. The modules were a great learning tool and I recommend implementing more rotations this way.
- Web was great. Really assisted in learning.
- I liked the web-based technology. I especially liked being able to interact with ISU and the other interns.
- Excellent. Great learning tool I wish we could have kept the CD ROM's because there was a ton of information available, good links and the audio and the movie clips were also excellent.
- I really loved it! It was very helpful to prepare for the rotations, I hope this continues possibly with other rotations – more modules.
- Modules were sometimes frustrating because they took so long to download.
- Hard to access links sometimes.
- It was neat but frustrating at times.
- It was wonderful—once we got rid of the computer glitches

This project demonstrated that interactive online instruction can be successfully incorporated into the dietetic internship program. Interns were receptive to, and used the instructional technology. Although both groups experienced improvement in their self-efficacy using the World Wide Web, the results for the experimental group were slightly better (p=.11). This improved comfort with technology is important since the RD exam is computerized and technology is permeating the professional workplace. This study also demonstrated that successful use of the technology was not exclusive to specific segments or characteristics of the study population; demographic factors, previous computer use, and preferred learning styles did not have a significant impact on the use of the technology. The fact that student's who preferred to work with others used the technology more indicated that the cooperative learning strategies and self-directed learning activities successfully engaged the learners. Thus, it appears that this interactive online instruction supports cooperative learning strategies, and can appeal to and be used by a broad student base.

This project also demonstrated that clinical competency can be improved with interactive online technology. One of the main objectives in the development of the online instruction was to standardize the experience interns receive in some areas of the medical nutrition therapy rotations. The data suggest this was accomplished. The rotations which characteristically exhibited greater variability in experiences, pediatrics and nutrition support, were those that had significant differences in performance between the control and experimental groups on the key feature exams.

The faculty working with the dietetic program have felt that the RD exam does not adequately assess practitioner competency. The data from this project support this belief. This was demonstrated by the significant relationship between the RD exam and the nutrition support calculations test, which measures rote arithmetic skills. Therefore, the significant relationship of the calculations test to the RD exam suggests that it may also measure rote knowledge, not clinical judgment and competency. The key feature exams developed in this project could serve as a template for including elements for testing clinical judgment and competency on the RD exam.

Future Considerations

- A longer intervention period (>8 weeks) is needed to truly assess change in computer attitudes. This study should be replicated once the entire dietetic internship (25 weeks) is converted to online instruction to evaluate the change in computer attitudes.
- Further examination of the predictors for success with this type of instructional format is warranted. The results of this study indicated that demographic factors, GPA, previous computer use and a variety of preferred learning styles did not significantly impact use or success with this mode of instruction. Yet, other factors such as computer accessibility, Myers Briggs Type Indicator, and Group Embedded Figures Test (another means to categorize learning styles), should be evaluated to successfully target this mode of instruction to the appropriate population.
- The findings of this study indicate the key feature exams should be examined as an alternative to the current RD exam format. Although clinical judgment, or competency, is difficult to evaluate the results of this project indicate that the key feature exam may be a viable tool.
- Additional methods of evaluating clinical judgment, or competency, need to be investigated. Currently most methods of evaluating competency are objectively based. Although the subjective component of competency is difficult to evaluate, it is a key element to assure competence in the healthcare delivery system.

APPENDIX A

COMPUTER ATTITUDES SURVEYS

Intern Survey

Name ____________________

Please complete this survey by choosing a response that most closely represents your opinion.

1. In order to be successful in the internship, how often do you believe you will need individual assistance from the instructor?
   a. Frequently
   b. Occasionally
   c. Rarely
   d. Never, or almost never

2. In order to be successful in the internship how often do you believe you will need computer technical assistance/support?
   a. Frequently
   b. Occasionally
   c. Rarely
   d. Never, or almost never

3. How many hours per week do you expect to spend outside scheduled facility time to complete assignments, prepare e-mails, and participate in chat rooms?
   _____ hours

4. Which of the following are effective ways for you to learn new material? Check all that apply.
   a. Having someone tell me information.
   b. Reading a textbook.
   c. Writing or typing my own notes.
   d. Observing and trying myself.
   e. Working on my own.
   f. Working with other students or peers.
   g. Working individually with an instructor.
   h. Having structured due dates.
   i. Working at my own speed.

5. During the past year, in a typical week how much time have you spent using a computer for any reason at home, work, or school?
   a. More than 40 hours
   b. 20 to 40 hours
   c. 10 to 19 hours
   d. 3 to 9 hours
   e. 1 to 2 hours
   f. Less than 1 hour
   g. No computer available/not applicable

6. Have you ever taken a Web-based course before?
   a. Yes
   b. No

Respond to each of the following items according to how strongly you feel about that item, using the following scale:

   a. Strongly Disagree
   b. Slightly Disagree
   c. Slightly Agree
   d. Strongly Agree

7. I don't have any use for computer technologies on a day-to-day basis.

8. Using computer technologies to communicate with others can help me to be more effective professionally.

9. I am confident about my ability to do well in a task that requires me to use computer technologies.

10. Using computer technologies will only mean more work for me.

11. I do not think that computer technologies will be useful to me in my profession.

12. I feel at ease learning about computer technologies.

13. With the use of computer technologies, I can create materials to enhance my professional development.

14. I am not the type to do well with computer technologies.

15. If I can use the world wide web, I will be more productive.

16. Anything that computer technologies can be used for, I can do just as well some other way.

17. The thought of using computer technologies frightens me.

18. Computer technologies are confusing to me.

19. I could use computer technologies to access many types of information sources.

20. I do not feel threatened by the impact of computer technologies.

21. I am anxious about computer technologies because I don't know what to do if something goes wrong.

22. Computer technologies can be used to assist me in organizing my work.

23. I don't see how I can use computer technologies to learn new skills.

24. I feel comfortable about my ability to work with computer technologies.

25. Knowing how to use computer technologies will not be helpful in my career.

I feel confident....

26. Accessing the world wide web with a web browser.

27. Using the web browser tool bar.

28. Using the web browser scroll bar.

29. Manipulating (move, minimize. maximize) a browser window.

30. Managing more than one web browser window.

31. Using hyperlinks to other websites in a web browser.

32. Using buttons and button bars in a web browser.

33. Printing from a web browser window.

34. Searching for information in a web browser.

35. Using an email system in a web browser.

36. Using a chat room in a web browser.

37. Using a bulletin board in a web browser.

38. Exiting the world wide web browser.

Respond to each of the following ten items according to how strongly you feel about that item, using the following scale:

a. Strongly Disagree
b. Disagree
c. Neither Agree/Disagree
d. Agree
e. Strongly Agree

39. Your belief that your computer skills could be enhanced.

40. Your belief that limited computer skills will hamper your professional development.

41. Your belief that enhancing your computer skills will make you a more competent professional.

42. Your desire to improve your computer skills.

43. Your knowledge to enhance your computer skills.

44. Your belief in yourself that you can improve your computer skills.

45. Your support system (internship faculty, family, friends) to help you improve your computer skills.

46. Your resources (internship faculty, preceptors, personal computer) to help you improve your computer skills.

47. Your belief in yourself that you can overcome personal barriers, such as lack of time or finances, to improve your computer skills.

48. Your belief in yourself that you can continue improving your computer skills throughout your professional career.

Respond to each of the following ten items according to how strongly you feel about that item, using the following scale:

a. Extremely Strong
b. Very Strong
c. Strong
d. Weak
e. Very Weak
f. Extremely Weak

39. My computer skills could be enhanced.

40. Limited computer skills will hamper my professional development.

41. Enhancing my computer skills will make me a more competent professional.

42. My desire to improve my computer skills.

43. My knowledge to enhance my computer skills.

44. I believe I can improve my computer skills.

45. My support system (internship faculty, family, friends) will help me improve my computer skills.

46. My resources (internship faculty, preceptors, personal computer) will help me improve my computer skills.

47. I can overcome personal barriers, such as lack of time or finances, to improve my computer skills.

48. I can continue improving my computer skills throughout my professional career.

Intern Survey

Name ________________

Please complete this survey by choosing a response that most closely represents your opinion.

1. How often did you request individual assistance from the instructor?
   a. Frequently
   b. Occasionally
   c. Rarely
   d. Never, or almost never

2. How often did you request technical assistance or support?
   a. Frequently
   b. Occasionally
   c. Rarely
   d. Never, or almost never

3. How many hours per week did you spend outside scheduled facility time to complete assignments, prepare e-mails, and participate in chat rooms?

   ______ hours

4. I believe the "web-based" experience was well-suited to way(s) I like to learn.
   a. definitely false
   b. more false than true
   c. in-between
   d. more true than false
   e. definitely true

5. Did you have problems accessing or using a computer? (please describe)

6. How long did it take you to get acclimated to taking the Web based course (accessing the Web page, navigating to right places, finding information when you needed it, etc.)?
   a. within the first week
   b. within the first month
   c. half-way through the modules
   d. never really became comfortable with the Web based course

7. The communication tools were easy to use (chatroom, message board, e-mail, etc.).
   a. strongly disagree
   b. disagree
   c. agree
   d. strongly agree
   e. not applicable

8. It was difficult to navigate through the modules.
   a. strongly disagree
   b. disagree
   c. agree
   d. strongly agree
   e. not applicable

9. The technology(ies) used in this course did not work in the way they were supposed to.
   a. strongly disagree
   b. disagree
   c. agree
   d. strongly agree
   e. not applicable

10. The instructor used the technology effectively to communicate learning objectives.
    a. strongly disagree
    b. disagree
    c. agree
    d. strongly agree
    e. not applicable

11. The instructor used the technology effectively to engage the interns.
    a. strongly disagree
    b. disagree
    c. agree
    d. strongly agree
    e. not applicable

Respond to each of the following items according to how strongly you feel about that item, using the following scale:

a. Strongly Disagree
b. Slightly Disagree
c. Slightly Agree
d. Strongly Agree

12. I don't have any use for computer technologies on a day-to-day basis.

13. Using computer technologies to communicate with others can help me to be more effective professionally.

14. I am confident about my ability to do well in a task that requires me to use computer technologies.

15. Using computer technologies will only mean more work for me.

16. I do not think that computer technologies will be useful to me in my profession.

17. I feel at ease learning about computer technologies.

18. With the use of computer technologies, I can create materials to enhance my professional development.

19. I am not the type to do well with computer technologies.

20. If I can use the world wide web, I will be more productive.

21. Anything that computer technologies can be used for, I can do just as well some other way.

22. The thought of using computer technologies frightens me.

23. Computer technologies are confusing to me.

24. I could use computer technologies to access many types of information sources.

25. I do not feel threatened by the impact of computer technologies.

26. I am anxious about computer technologies because I don't know what to do if something goes wrong.

27. Computer technologies can be used to assist me in organizing my work.

28. I don't see how I can use computer technologies to learn new skills.

29. I feel comfortable about my ability to work with computer technologies.

30. Knowing how to use computer technologies will not be helpful in my career.

I feel confident....

31. Accessing the world wide web with a web browser.

32. Using the web browser tool bar.

33. Using the web browser scroll bar.

34. Manipulating (move, minimize, maximize) a browser window.

35. Managing more than one web browser window.

36. Using hyperlinks to other websites in a web browser.

37. Using buttons and button bars in a web browser.

38. Printing from a web browser window.

39. Searching for information in a web browser.

40. Using an email system in a web browser.

41. Using a chat room in a web browser.

42. Using a bulletin board in a web browser.

43. Exiting the world wide web browser.

APPENDIX B

KEY FEATURE EXAMS

NAME______________________________

TC is an 85 y/o male who is 6' tall and weighs 145#. TC presented to the ER with left sided hemiparesis, aphasia and wife reports altered mental status over the past few days. His wife reports that his high blood pressure has not been well controlled with medication and he has a history of constipation. She thinks he has lost weight -he generally weighs 170#; he hasn't been as mobile the past few months so she hasn't weighed him. His labs in the ER were:

albumin	3.1 gm/dL
cholesterol	135 mg/dL
prealbumin	13 mg/dL
triglycerides	165 mg/dL
Na	138 mEq/L
K	4.0 mEq/L
glucose	85 mg/dL

A swallow evaluation was ordered and the Speech Pathology reports extreme risk for aspiration. Upon visiting the patient you find the wife feeding TC a glass of eggnog through a straw, 'his favorite'. TC's Braden score was 10.

1. What one specific concern would you address with TC's wife?

2. What is the most appropriate means to provide adequate nutrition for TC? (Be specific)

3. What parameters would you use to follow the progress of TC?

4. Identify the four most relevant nutrition problems TC exhibits or is at increased risk of developing.

deficit in nutrition education
deficit in nutrition knowledge
nutrition misinformation
inadequate caloric intake
inadequate feeding route
inadequate protein intake
altered body composition
impaired growth/development
overweight status
underweight status
undesirable weight change
fluid imbalance
electrolyte imbalance
intolerance to food/nutrient
potential for disease
altered nutrient function
altered metabolism
inappropriate feeding route
inappropriate dietary habits
inappropriate food role/food abuse
misuse of nutrient supplement
misuse of enteral product
misuse of parenteral product
misuse of therapeutic diet
undesirable food/nutrient interaction
altered nutritional biochemistry
undesirable food/treatment schedule
altered nutrient disposition

NAME______________________

SS is a 54 y/o female with no major illnesses. Her past medical history includes obesity and bilateral degenerative joint disease in her knees. She complains of early satiety, alternating constipation and diarrhea. When SS was admitted to the hospital a 35# weight loss over the past 4-5 months was documented; admit height and weight were 5'6" and 155#. Her admit labs were:

albumin	3.3 gm/dL
cholesterol	165 mg/dL

An upper GI endoscopy and colonoscopy were scheduled for SS. The colonoscopy revealed malignant polyps beginning in the sigmoid colon extending into the descending colon. SS was scheduled for a colon resection. The pathology report from surgery documented Duke's cancer, stage III, and 1 of 20 lymph nodes was positive. SS will undergo concomitant radiation and chemotherapy over the next year.

SS has now been NPO with IV of D5W for 5 days post operatively. Her abdomen is distended and firm, no bowel sounds, flatus, or stools per ostomy.

1.Given the presentation of SS, how would you classify her nutritional risk?

____none   _____low risk   ______moderate risk   ______high risk

2. How would you estimate SS caloric and protein needs? Show rationale and calculations.

3. What is the most appropriate means to provide adequate nutrition for SS? (Be specific).

4. What parameters would you use to follow the progress of SS?

5. Identify the four most relevant nutrition problems in this case presentation:

deficit in nutrition education
deficit in nutrition knowledge
nutrition misinformation
inadequate caloric intake
inadequate feeding route
inadequate protein intake
altered body composition
impaired growth/development
overweight status
underweight status
undesirable weight change
fluid imbalance
electrolyte imbalance
intolerance to food/nutrient
potential for disease
altered nutrient function
altered metabolism
inappropriate feeding route
inappropriate dietary habits
inappropriate food role/food abuse
misuse of nutrient supplement
misuse of enteral product
misuse of parenteral product
misuse of therapeutic diet
undesirable food/nutrient interaction
altered nutritional biochemistry
undesirable food/treatment schedule
altered nutrient disposition

NAME______________________

Jake is a 13 y/o boy who is very active in school activities and sports. He presents to the pediatrician's office with flu-like symptoms. He complains of fatigue, lack of energy, difficulty concentrating, and insatiable thirst and appetite. His mother states he has lost weight in the last 3-4 weeks, maybe 10-15# (his usual weight is 135#). She comments he's been using the bathroom at night recently too.

Labs:

albumin	3.8 gm/dL
triglycerides	260 mg/dL
glucose	620 mg/dL
cholesterol	184 mg/dL
LDL	130 mg/dL
hgb A_1C	9%

1. What symptoms and biochemical parameters in Jake's presentation are most relevant to your assessment? List as many as relevant.

2. Calculate the % weight loss Jake has experienced.

__________% weight loss

3. Identify the three most relevant nutritional problems related to Jake's case.

deficit in nutrition education	potential for disease
deficity in nutrition knowledge	altered nutrient function
nutrition misinformation	altered metabolism
inadequate caloric intake	inappropriate feeding route
inadequate feeding route	inappropriate dietary habits
inadequate protein intake	inappropriate food role/food abuse
altered body composition	misuse of nutrient supplement
impaired growth/development	misuse of enteral product
overweight status	misuse of parenteral product
underweight status	misuse of therapeutic diet
undesirable weight change	undesirable food/nutrient interaction
fluid imbalance	altered nutritional biochemistry
electrolyte imbalance	undesirable food/treatment schedule
intolerance to food/nutrient	altered nutrient disposition

Jake was admitted to the hospital. Prior to Jake's discharge from the hospital you have two 1 hour sessions to counsel Jake and his parents. Jake will be returning to pediatrician's 1 week after discharge.

4. What information do you need to gather from Jake? List as much information as relevant.

5. What does Jake need to understand prior to returning to the outpatient clinic.

NAME________________________

Nicole, 3 months old, presents at the local WIC Clinic with her mother for issuance of infant formula vouchers. Mother is homeless and has been living with friends and at shelters. The WIC Clinic nurse has referred Nicole to you for evaluation. The nurse's assessment documents a birth weight of 5# 1oz and delivery 3 ½ weeks premature. Present weight is 7# 9oz, recumbent length 21 ¾", and OFC 14 ¾". Mom reports that she received some infant formulas from a friend, has tried to 'stretch' the formula, but now has run out. Mom reports that Nicole takes approximately 2-3 oz of formula every 4-6 hours. A finger stick in the clinic reveals a hemoglobin of 9.8 gm/dL.

1. Estimate Nicole's daily caloric intake.

_____________ kcal

2. Estimate Nicole's daily caloric needs.

_____________ kcal

3. Idenftify the three most relevant nutritional problems in Nicole's case.

deficit in nutrition education
deficity in nutrition knowledge
nutrition misinformation
inadequate caloric intake
inadequate feeding route
inadequate protein intake
altered body composition
impaired growth/development
overweight status
underweight status
undesirable weight change
fluid imbalance
electrolyte imbalance
intolerance to food/nutrient
potential for disease
altered nutrient function
altered metabolism
inappropriate feeding route
inappropriate dietary habits
inappropriate food role/food abuse
misuse of nutrient supplement
misuse of enteral product
misuse of parenteral product
misuse of therapeutic diet
undesirable food/nutrient interaction
altered nutritional biochemistry
undesirable food/treatment schedule
altered nutrient disposition

5. What additional information would you obtain to complete a nutritional assessment of Nicole? List as much information as relevant.

NAME____________________________

Jo is a 56 y/o caucasian female patient with diabetic neuropathy and retinopathy. She has been referred to the outpatient dietitian for medical nutrition therapy. The physician has asked for the dietitian's recommendations on diet and to proceed with education for this client. Jo is 5'2", 134# and her medications include NPH/Humalog, Captopril, and Tums.

Labs:	3/98	6/98
BUN	74 mg/dL	83 mg/dL
Cr	3.8 mg/dL	4.8 mg/dL
K+	5.0 mEq/L	5.4 mEq/L
PO4	5.1 mg/dL	6.0 mg/dL
glucose	190 mg/dL	220 mg/dL
albumin	3.5 mg/dL	3.3 mg/dL
Ca	9.6 mg/dL	7.8 mg/dL

1. What pieces of information in Jo's presentation are most relevant to your assessment? List as many as relevant.

2. What information do you need to obtain to complete the nutritional assessment of Jo? List as much information as relevant.

3. What nutrition intervention is appropriate for Jo?

4. Identify the three most relevant nutrition problems in Jo's case.

deficit in nutrition education
deficit in nutrition knowledge
nutrition misinformation
inadequate caloric intake
inadequate feeding route
inadequate protein intake
altered body composition
impaired growth/development
overweight status
underweight status
undesirable weight change
fluid imbalance
imbalance
intolerance to food/nutrient

potential for disease
altered nutrient function
altered metabolism
inappropriate feeding route
inappropriate dietary habits
inappropriate food role/food abuse
misuse of nutrient supplement
misuse of enteral product
misuse of parenteral product
misuse of therapeutic diet
undesirable food/nutrient interaction
altered nutritional biochemistry electrolyte
undesirable food/treatment schedule
altered nutrient disposition

NAME________________________

Bob is a 45 y/o male diabetic who has been on dialysis for four years. He currently receives hemodialysis three times per week for 3 hours each time. His dialysate bath is 143 Na, 1.0 K+, 2.0 Ca++, 200% dextrose. He is on a high protein, low salt, low potassium, low phosphorus diet with a 1500cc fluid restriction. Periodically, Bob has problems with GI bleeding. He has a very good appetite and his usual diet and medication compliance history includes sporadic refusal of medications and use of alternative therapies.

Monthly lab values and weights:

	Urine Output (cc)	Mean Pre-Dial Weight (kg)	Mean Post-Dial Weight (kg)	BUN	Cr	K+	Ca++	PO4
July	800cc	93	89	43	4.2	5.7	8.7	3.4
Aug	650cc	94	90	55	5.1	6.0	8.2	5.4
Sept	700cc	93	88	59	5.4	6.2	8.7	7.0
Oct	500cc	89	84	54	5.2	6.4	8.8	4.9
Nov	400cc	91	86	46	4.9	6.7	8.9	3.9
Dec	350cc	93	87	50	5.7	6.5	8.6	4.0

Bob presents to the dialysis unit on a non-dialysis day complaining of weakness, leg cramping, and diarrhea. Bob is 5'10" and weighs 185#; labs at this time were:

BUN	58 mg/dL
Cr	6.3 mg/dL
Na	128 mEq/L
K+	7.2 mEq/L
glucose	350 mg/dL
PO4	6.8 mg/dL
albumin	3.7 gm/dL
Ca	8.2 mg/dL
PTH	682 pg/ml

1. What **one specific** piece of information do you need to obtain from a diet history?

2. What pieces of information not related to the diet history do you need?

3. Identify the four most relevant nutritional problems you have identified.

deficit in nutrition education	potential for disease
deficit in nutrition knowledge	altered nutrient function
nutrition misinformation	altered metabolism
inadequate caloric intake	inappropriate feeding route
inadequate feeding route	inappropriate dietary habits
inadequate protein intake	inappropriate food role/food abuse
altered body composition	misuse of nutrient supplement
impaired growth/development	misuse of enteral product
overweight status	misuse of parenteral product
underweight status	misuse of therapeutic diet
undesirable weight change	undesirable food/nutrient interaction
fluid imbalance	altered nutritional biochemistry
electrolyte imbalance	undesirable food/treatment schedule
intolerance to food/nutrient	altered nutrient disposition

4. What nutritional intervention do you need to address with Bob?

APPENDIX C

HUMAN SUBJECTS REVIEW

Information for Review of Research Involving Human Subjects

Iowa State University

(Please type and use the attached instructions for completing this form)

1. Title of Project: Evaluating the Use of Online Instruction in a Dietetic Internship

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are protected. I will report any adverse reactions to the committee. Additions to or changes in research procedures after the project has been approved will be submitted to the committee for review. I agree to request renewal of approval for any project continuing more than one year.

Typed name of principal investigator	Date	Signature of principal investigator
Ruth Litchfield	10/8/98	[signature]

Department	Campus address
Food Science/Human Nutrition	1127 HNSB

Phone number to report results: 294-9484

3. Signatures of other investigators

Signatures of other investigators	Date	Relationship to principal investigator
Mary Jane Oakland [signature]	10/8/98	Major Professor
Jean Anderson [signature]	10/8/98	Staff Member

4. Principal investigator(s) (check all that apply)
   ☒ Faculty ☒ Staff ☒ Graduate student ☐ Undergraduate student

5. Project (check all that apply)
   ☒ Research ☒ Thesis or dissertation ☐ Class project ☐ Independent Study (490, 590, Honors project)

6. Number of subjects (complete all that apply)
   ____ # adults, non-students ____ # ISU students ____ # minors under 14 ____ # minors 14 - 17 ____ other (explain)

7. Brief description of proposed research involving human subjects: (See instructions, item 7. Use an additional page if needed.)

   Online instruction modules will be included in the Dietetic Internship to support the distance education format of the internship. The technology will be evaluated for ease of use, enhancement of the internship experience, and impact on success of intern performance.

(Please do not send research, thesis, or dissertation proposals.)

8. Informed Consent:
   ☒ Signed informed consent will be obtained. (Attach a copy of your form.)
   ☐ Modified informed consent will be obtained. (See instructions, item 8.)
   ☐ Not applicable to this project.

GC 1/98

9. Confidentiality of Data: Describe below the methods you will use to ensure the confidentiality of data obtained. (See instructions, item 9.)

    Complete anonymity and confidentiality will be maintained as participant identification will not be recorded in any way that it could be recalled and/or matched to a particular subject. All data collected on each intern will be assigned a code number for analytical purposes.

10. What risks or discomfort will be part of the study? Will subjects in the research be placed at risk or incur discomfort? Describe any risks to the subjects and precautions that will be taken to minimize them. (The concept of risk goes beyond physical risk and includes risks to subjects' dignity and self-respect as well as psychological or emotional risk. See instructions, item 10.)

    There will be no additional activities or assignments beyond the expected internship experience required. Interns are aware of expectations of the internship experience when applying for the program.

11. CHECK ALL of the following that apply to your research:

- ☐ A. Medical clearance necessary before subjects can participate
- ☐ B. Administration of substances (foods, drugs, etc.) to subjects
- ☐ C. Physical exercise or conditioning for subjects
- ☐ D. Samples (blood, tissue, etc.) from subjects
- ☐ E. Administration of infectious agents or recombinant DNA
- ☐ F. Deception of subjects
- ☐ G. Subjects under 14 years of age and/or ☒ Subjects 14 - 17 years of age
- ☐ H. Subjects in institutions (nursing homes, prisons, etc.)
- ☐ I. Research must be approved by another institution or agency (Attach letters of approval)

If you checked any of the items in 11, please complete the following in the space below (include any attachments):

Items A–E Describe the procedures and note the proposed safety precautions.

Items D–E The principal investigator should send a copy of this form to Environmental Health and Safety, 118 Agronomy Lab for review.

Item F Describe how subjects will be deceived; justify the deception; indicate the debriefing procedure, including the timing and information to be presented to subjects.

Item G For subjects under the age of 14, indicate how informed consent will be obtained from parents or legally authorized representatives as well as from subjects.

Items H–I Specify the agency or institution that must approve the project. If subjects in any outside agency or institution are involved, approval must be obtained prior to beginning the research, and the letter of approval should be filed.

Last name of Principal Investigator [illegible]

Checklist for Attachments and Time Schedule

The following are attached (please check):

12. ☐ Letter or written statement to subjects indicating clearly:
    a) the purpose of the research
    b) the use of any identifier codes (names, #'s), how they will be used, and when they will be removed (see item 17)
    c) an estimate of time needed for participation in the research
    d) if applicable, the location of the research activity
    e) how you will ensure confidentiality
    f) in a longitudinal study, when and how you will contact subjects later
    g) that participation is voluntary; nonparticipation will not affect evaluations of the subject

13. ☐ Signed consent form (if applicable)

14. ☐ Letter of approval for research from cooperating organizations or institutions (if applicable)

15. ☐ Data-gathering instruments

16. Anticipated dates for contact with subjects:

First contact [illegible]
Month/Day/Year

Last contact [illegible]
Month/Day/Year

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased.

[illegible]
Month/Day/Year

18. Signature of Departmental Executive Officer [illegible] Date [illegible] Department or Administrative Unit Food Science and Human Nutrition

19. Decision of the University Human Subjects Review Committee:

☒ Project approved ☐ Project not approved ☐ No action required

Patricia M. Keith
Name of Committee Chairperson

[illegible]-15-98
Date

[illegible]
Signature of Committee Chairperson

APPENDIX D

CONSENT FORM

Evaluation of Dietetic Education

You have the opportunity participate in a research study conducted by Iowa State University evaluating the effectivness of technology in dietetic education. All data collected on each intern will be assigned a code number for analytical purposes. Complete anonymity and confidentiality will be maintained as participant identification will not be recorded in any way that it could be recalled and/or matched to a particular subject. You may choose to terminate your participation at any point in the study without consequence. The following describes the commitment required to participate in this study.

Case Studies
Completion of three case studies at the midpoint and completion of the medical nutrition therapy rotations within the dietetic internship. These case studies will be administered when you are on campus for case study presentations and will take approximately 30-40 minutes.

Demographic Information
Demographic information will be acquired for each subject from their dietetic internship application file. Information to be collected include: age, sex, overall GPA, science GPA, didactic coursework GPA, and work experience.

Dietetic Internship Activities
Completion of the assigned activities and assignments required for successful completion of the dietetic internship; no additional activities are requested or required.

Registration Exam Scores
Release of your scores on the Registration Examination for Registered Dietitians by the Commission on Dietetic Registration to the Dietetic Internship at Iowa State University.

I have read and understand the instructions given above. As indicated by my signature below, I voluntarily consent to serve as a subject in the project explained above, "Evaluation of Dietetic Education." I agree to provide information that is accurate to the best of my knowledge.

NAME (please print)	Age	Signature	Date

Contact:
Ruth Litchfield, MS, RD, LD
Practicum Coordinator/Adjunct Instructor
1127 HNSB
ISU
Ames, IA 50011-1120
(515)294-9484

APPENDIX E

ANOVA PROGRAM

```
UNIANOVA
    pedk BY group location class
    /RANDOM = location class
    /METHOD = SSTYPE(3)
    /INTERCEPT = INCLUDE
    /CRITERIA = ALPHA(.05)
    /DESIGN = group location class (location*group)
```

APPENDIX F

LINEAR REGRESSION PROGRAM

```
UNIANOVA
    Useful by group location class amtwork typework WITH age sciengpa dpdgpa gpa
    /RANDOM = location class
    /METHOD = SSTYPE(3)
    /INTERCEPT = INCLUDE
    /PRINT = PARAMETER
    /CRITERIA = ALPHA(.05)
    /DESIGN = group location class (location*group) amtwork typework age sciengpa
        dpdgap gpa
```

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