USE OF DISTANCE LEARNING TECHNOLOGY TO TEACH A MULTIDISCIPLINARY COURSE:PHYTOCHEMICALS IN FRUITS AND VEGETABLES

Kim E. Dooley
Texas A&M University
Bhimanagouda S. Patil
Texas A&M University-Kingsville
R. Daniel Lineberger
Texas A&M University

Abstract

Most of our universities are using, or exploring the use of, distance education as a delivery system for courses, degrees, and continuing education. *Phytochemicals in Fruits and Vegetables to Improve Human Health* was developed and delivered as a new graduate course in spring, 1999. Distance learning technology provided the conduit for interaction among 18 faculty/researchers across the nation and a diverse group of learners in 10 videoconferencing sites. Weekly topics and discussion were delivered via the Trans-Texas Videoconference Network (TTVN) with course handouts and PowerPoint slides available on a course Web site. Formative and summative evaluations were collected on-line and stored in a database. An external evaluator observed the course and kept a field journal, compiled numerical ratings, and completed the constant comparative method to integrate categories on all open-ended responses. The most beneficial component of the course was access to national experts/presentations and the relevancy of research applications to a geographically dispersed audience. Only through distance education was this approach possible. The initial evaluative results will be implemented for the revision of this course and practical recommendations will be shared.

Introduction: Why Distance Learning?

In *Reclaiming a Lost Heritage* (1995), John Campbell focuses on the value and necessity for education in a society that embraces democracy and free enterprise. "Technology has now changed or altered how people access, gather, analyze, present, transmit, and simulate information. Today's technologies provide the tools, applications, and processes that empower individuals of our information society" (See, 1994, p. 30). Advances in scientific developments, telecommunications, information processing, and dissemination technologies are accelerating knowledge generation and acquisition (Hefzallah, 1990). There is escalating awareness that our educational systems are facing inordinate difficulties in trying to meet the needs in our changing and increasingly technological society. In the next century, how will higher education institutions ensure access to lifelong learning?

Most of our universities are using, or exploring the use of, distance education as a delivery system for courses, degrees, and continuing education. Many question the "quality" and rigor of distance education and compare "traditional" classrooms to technology-mediated delivery. Many researchers argue that these comparative studies are of little or no value. The predominance of "no significant difference" findings has led them to conclude that delivery systems do not matter (Russell, 1996). "Comparative studies of mediated education do not address the question of quality of learning and teaching in the right frame. These studies are grounded in the mechanical view of mediated communication and the physical science paradigm of educational technology" (Saba, 1999, p. 29). Clark (1983) argued that media were mere vehicles used to deliver instruction and that it is the method rather than the media that affects learning. Research that considers the use of "systems approaches" to describe distance education and define a set of prescriptive principles for its effective use are necessary (Saba, 1999; Smith & Dillon, 1999a). "A systems theory of distance education helps us understand that 'distance' is not a product of geography, but rather it is a function of the relationship between structure and dialogue" (Smith & Dillon, 1999b).

Theoretical Framework: Why Phytochemicals?

Historically, consumption of certain fruits and vegetables was thought to prevent or cure ailments ranging from headaches to heart diseases. In fact, early medicine revolved largely around the prescription of specific plant food concoctions for certain health disorders (Darby, Ghalioungi & Grivetti, 1977; Kohman, 1947). In the history of mankind, there has always been the awareness that the composition and quality of the diet have a strong impact on maintaining good health. Parents encourage children to eat fruits and vegetables because they help the children "grow big and strong." However, only one percent of children from two to 19 years old meet the U.S. Department of Agriculture's dietary guidelines (Munoz, Krebs-Smith, Ballard-Barbash & Cleveland, 1997).

Until relatively recently, these attributes of fruits and vegetables were based more on metaphysical beliefs than on scientific evidence, but during the past decade many studies examined the relationship between the consumption of fruits and vegetables and human health. Besides being the main source of dietary fiber and vitamins, fruits and vegetables contain more useful compounds. They contain a myriad of phytochemicals or bioactive compounds shown to have anti-inflammatory, antioxidant, and healing effects. These include carotenoids, flavonols, flavones, tocopherol, selenium, phenols, protease inhibitors, organosulphur compounds, limonoids, and plant sterols (Potter & Steinmetz, 1996; Fahey, Zhang & Talalay, 1997).

Review of the epidemiological data, including both cohort and case-control studies of all cancer sites, strongly suggests that plant foods have the potential to prevent diseases. These plant foods include vegetables such as broccoli, onion, carrots, tomatoes, lettuce, celery, cucumber, endive, parsley, radish as well as citrus fruits, grape, coffee, and tea. For example, the protective role of carotenoid-rich fruits and vegetables in prevention of heart diseases, cancer, and advanced age-related macular degeneration is well documented (Gaziano, Manson, Branch, Colditz, Willet & Buring, 1995; Morris, Kritchevsky & Davis, 1994; Seddon, Ajani, Sperduto, Hiller, Blair, Burton, Farber, Gragoudas, Haller, Miller, Yannuzi, & Willet, 1994; Van Poppel, 1993). Even the aging process appears to be favorably influenced by increased intake of fruits and vegetables (Gerster, 1997). It has been established that the large intake of fruits and vegetables is associated with decreased incidence of cancer and mortality in several human cohort sites (Hiryama, 1985; Doll, 1990).

The National Academy of Science unraveled an important report on *Diet, Nutrition and Cancer* in 1992. This report emphasized the relationship between diet and cancer and offered specific dietary suggestions. The Surgeon General's Report on Nutrition and Health in 1988 revealed that five of every 10 deaths in the U.S. were attributed to diet-related diseases. The strategy in the war against human diseases needs to be revised. A major emphasis on prevention rather than cure needs to be implemented through education in agriculture and food science curricula. Even though we have evidence suggesting the importance of fruits and vegetables, there were no specific courses designed to teach students about the phytochemicals contained in fruits and vegetables.

Course Design and Delivery

In the fall of 1998, Texas A&M University-Kingville Citrus Center was awarded a USDA Challenge Grant to develop a new course: *Phytochemicals in Fruits and Vegetables to Improve Human Health*. This course, delivered in spring, 1999, was the first in the nation to combine experts from chemistry, plant physiology, horticulture, plant breeding, food science, plant pathology, biochemistry, postharvest physiology, and the medical sciences in the discussion of phytochemicals. Although it was designed as a graduate-level course, upper-level undergraduates and professionals in the field seeking continuing education credit also participated. Interaction among 18 instructors and 32 students at 10 videoconference locations was accomplished via an interactive video network supported through the Texas A&M University System. The Trans-Texas Videoconference Network (TTVN) has approximately 100 videoconference sites across Texas and at international locations in Mexico and Central America. It is a full-duplex system using dedicated T-1 circuits to transmit audio, video, and data. Phytochemical information was delivered through PowerPoint® presentations, slides, demonstrations, video clips, and discussion. Course handouts and PowerPoint were provided to learners on a course Web site (http://phytochemicals.tamu.edu).

A basic premise of the course design was to shift significantly away from the traditional lecture style by one instructor to a learning environment enhanced by distance education with several instructors. Many studies have shown that the lecture hall is not an effective learning environment (Laws, 1991) and that a mixture of discovery, Socratic dialogue (Hake, 1994) and lecture with the demonstration of experimental results increases understanding and retention. As described in *Everybody Counts*, the teacher's role should shift to that of consultant, moderator, and interlocutor, not just presenter and authority (National Research Council, 1989).

Course Objectives and Purpose of the Evaluative Study

The primary objective of the course was to provide opportunities for students to acquire interdisciplinary knowledge related to the effect of fruits and vegetables on human health. A second objective was to make students aware of careers in health-related interdisciplinary fields, and increase their knowledge and understanding of the relationships between research findings and the practical use of phytochemicals. The third objective was to analyze how well the course, as designed and delivered, met the first two objectives. What were the student perceptions of this multi-teacher, multi-location (distance education) approach?

Methods

There were 32 students enrolled in this course within three university systems—The Texas A&M University System, The University of Texas System, and Texas Tech University. Because of the unique challenges of a multidisciplinary approach coupled with the use of distance-learning technologies, educational evaluation (with both numerical and open-ended responses) was the method employed (Borg & Gall, 1989). A formative evaluation was administered to determine the effectiveness of the presenters, students' understanding of content presented, usefulness of supplemental materials, the quality of the videoconference transmission, and whether students perceived the "right mix" of interaction between the "lecture" and discussion components of the course. These data were collected through the course Web site and stored in a database; therefore, the number of responses for each topic varies. The means for the numerical ratings were calculated for each question. Student location was indicated to determine any differences between "local" and "remote" sites. Students were also asked for "responsive evaluation" (Stake, 1967) on the most and least beneficial aspects of each session.

At the conclusion of the course, an open-ended, on-line evaluation was collected for all students enrolled and standard course evaluation forms were administered at 2 sites (College Station and Weslaco). An external evaluator observed the course and kept a field journal about the learning environment, compiled numerical ratings, and used the constant comparative method to 1) compare incidents applicable to each category and 2) integrate categories on

all open-ended responses (Lincoln & Guba, 1985; Glasser & Strauss, 1967). All on-line responses were coded to ensure confidentiality and stored in a database on the server of the external evaluator.

Findings

The findings are divided into four sections: 1) *Formative Data* with numerical averages for each topic and integrated categories for all open-ended responses, 2) *Summative Data* of open-ended responses collected on-line at the completion of the course, 3*) Standard Course Evaluations* forms administered through The Texas A&M University System only, and 4) *Discussions of Results* drawn from the data analysis.

Formative Evaluation Numerical Ratings and Discussion of Open-Ended Responses

For each topic throughout the semester, students were asked to complete an on-line evaluation instrument (with 1 being the lowest and 5 the highest) for the following questions: 1) How would you rate this presenter (preparedness, enthusiasm, delivery techniques)?; 2) How well did you understand the content?; 3) Did the supplemental materials help (PowerPoint slides, other visuals, handouts)?; and 4) How would you rate the videoconference transmissions (audio, video, interaction with other sites, etc.)? The students were also asked, "Did the session have the right mix of lecture and discussion/interaction" and this could be indicated by a "yes" or "no" answer (see Table 1). Following these five questions, there were three open-ended questions: 1) What was the most beneficial part of the presentation? 2) What was the least beneficial part of the presentation? and 3) Other comments or recommendations.

Table 1.
Numerical Ratings on Formative Evaluation

Topic	Presenter Rating	Student Understanding	Supplemental Materials	VC Transmission	Right Mix % "yes"	Number of Respondents (n)
antioxidants	3.9	4.1	3.4	3.9	86%	7
beta-carotene	4.3	4.2	4.2	4.5	100%	11
cancer chemo-prevention	4.0	3.5	3.8	2.5	50%	4
carotenoids	4.6	4.2	4.5	3.8	100%	14
citrus limonoids	3.8	2.9	2.8	3.1	60%	15
community-based programs	3.8	4.3	3.3	3.4	88%	16
crucifers	3.8	3.8	3.4	2.4	82%	17
designer fruits	4.2	4.1	4.2	4.4	100%	9
diet & prostate	3.9	3.2	3.3	3.1	60%	10
flavonoids	4.4	4.0	4.2	3.8	80%	5
isoflavones	3.8	4.0	3.8	3.3	100%	8
myristicin	3.6	3.6	3.8	3.2	80%	5
nutrition & cancer	3.8	3.5	4.0	3.2	55%	28
onion & antiplatelet	4.7	4.5	4.4	4.1	100%	10
wine & health	4.4	4.4	4.5	4.3	91%	11
AVE %	**4.1**	**3.9**	**3.8**	**3.5**	**82%**	**11**

In addition to the numerical ratings, the open-ended responses were analyzed and integrated into the following six categories: 1) presenter qualities, 2) contributions to student understanding, 3) effectiveness of supplemental materials, 4) quality of videoconference transmission, 5) most beneficial, and 6) least beneficial aspects of the course. Student responses on presenter qualities included: clear pronunciation, detailed presentations, good discussion of complex subject matter; thorough coverage of content; interesting content; scientific application, outstanding preparation, excellent overview, willingness to answer questions, knowledgeable about subject matter, genuine interest, enthusiasm, humor, and using real research data to demonstrate principles. Students also commented that presentations that were fun to listen to, used discussion and had relevancy to "real-world" applications helped increase understanding of the course content. The use of slides, handouts, bar graphs, visual aids of actual objects, "lecture" notes/PowerPoint slides and video were appropriate and useful supplemental materials.

Although videoconferencing provided the conduit for the course delivery, there were some sites that were not connected the entire time of a particular class session and therefore missed a portion of the class. There were frequent audio difficulties, often caused by connection problems, a lack of facilitation/technician assistance at distance sites, misunderstandings about muting functions, and because some speakers did not speak directly into the microphones. Visuals were often hard to read on the TV monitors and students wanted to see more of the speaker rather than only the visuals during the presentations.

Overall, the most beneficial component of the course was the diversity of speakers/presentations and the relevancy of research applications. Some students did comment that there was too much detailed information (especially chemistry). The accents of some presenters were hard to understand and it was often hard to follow the "lecture" because PowerPoint slides were not in the same order as the presentation during delivery.

Some presentations were perceived to lack clear organization and appeared rushed, especially when there were two speakers for one class session. Speakers often prepared so much material that there was no time for breaks or class discussion, causing frustration and information overload.

Summative Evaluation Based upon Open-Ended Responses

At the conclusion of the course, students were asked to complete an on-line, open-ended, evaluation instrument. This summative evaluation included 8 questions and the opportunity to add additional comments and suggestions. There were 8 respondents who completed the summative evaluation. These questions and a summary of comments are documented in this section.

1. In your opinion, was distance education an effective way to deliver this course? Although students mentioned some obstacles to the videoconference delivery (especially audio as mentioned previously), students felt that it was interesting to have speakers from all over the nation and to be able to reach a diverse audience of learners. The interaction with multiple sites and diverse speakers and students was unique and a strength of the course. One student commented, "With the speakers being dispersed, this was the only way to offer a course of this type."
2. Should this type of technology be used in the future? Every respondent agreed—this technology allowed more speakers to come together and offer their knowledge and expertise to a wider audience.
3. If you took this course with an instructor in the traditional classroom, do you think you would have gained more knowledge? This question had a mixed response. Those who said, "yes" felt the course was too intense, especially in a three-hour, once-a-week format. They suggested a shorter time frame with more frequent meetings. The issue of "accents" of the speakers was mentioned as a barrier to learning, this being intensified by the audio difficulties experienced with videoconferencing. Those who answered, "no" once again emphasized the ability to garner knowledge from instructors all over the US with diverse research backgrounds compared to the knowledge base of one instructor in the traditional classroom.
4. Did the topics enhance your understanding of phytochemicals in fruits and vegetables? The answer unequivocally was "yes."
5. Were there topics needing to be covered that were not? Answers varied based upon the diverse nature of the student backgrounds. Topics mentioned were processing effects on each of the chemicals' dietary aspects, ethnobotanical or historical aspects, and less on specific foods and more on phytochemicals per se.
6. Were there any topics covered in too much detail? Many students mentioned that there was too much chemistry and biochemical structures. Some felt there was a bias toward citrus and others felt there was too much information on growing crops and plant disease rather then the aspects of phytochemicals in relation to health issues.
7. Would you recommend this course to others? Once again every respondent said "yes" but they did mention that perhaps it should be limited to graduate students or have a pre-requisite of biochemistry/chemistry.
8. What suggestions for improvement would you make? Answers varied and many have been mentioned previously: the course was too intense in a 3-hour block; need to have local facilitators; implement more written assignments and fewer exams; make sure speaker slides are in the order they will present and formatted for TV monitor display; provide technical support for correcting transmission difficulties; create a manual that lists foods and phytochemicals as a course reference; if the course continues to have a broad audience, then have less detailed content; provide streaming video of lectures over the Internet; and provide review questions before or right after the "lectures."

Standard Course Evaluation Results

Standard course evaluation forms were administered for The Texas A&M University System with 14 respondents -- Kingsville (Table 2) and College Station (Table 3). The instruments had different questions and will be discussed separately. Both forms used a 1-5 scale with 5 being the "best" or "strongly agree."

At Texas A&M University – Kingsville, the seven respondents were all graduate students with three indicating that this course would be used in their "major." The others listed it as an "elective" course.

There was also an open-ended question on the Texas A&M University - Kingsville form, "Please give your views on the quality of the learning experience in this course. In your comments, please include both strengths and weaknesses." Student responses were overwhelmingly positive. "There should be more courses like this! Not only the subject matter, but the format (teleconferencing links to multi-educational sites, with the experts in their fields)."

"This course was very informative. The material taught was very new…a new concept in the way scientists are approaching killer diseases. This is very exciting because scientists are starting to look around at our environment and are going back to plants for cures."

Several students mentioned the technical difficulties with the videoconferencing, but did not imply that it was a hindrance to learning. "There are still some technical problems regarding TTVN; if we can resolve that in the future it would be much better." "Once technical problems are worked out, there shouldn't be any more problems!"

Table 2.
Texas A&M University – Kingsville Student Evaluation Results

Question	Rating
This course promotes a challenging learning environment for students.	4.86
This course inspires high academic standards and goals in students.	4.71
An atmosphere of mutual respect and civility is encouraged in this course.	4.86
The subject matter in this course is presented in a clear and organized manner.	4.71
Tests and other requirements cover the course material as stated in the syllabus.	4.86
The grading system outlined in the syllabus is followed.	4.71
The instructor is accessible outside of class.	4.86
Lectures and discussions focus on the material outlined in the syllabus.	4.86
The results of tests and assignments are returned in a reasonable time.	4.86
The textbook(s) and/or other required materials contribute to my understanding of the subject.	4.86
Students are offered help and encouragement in this course.	4.71
A student's ability to think (analytically, critically, creatively, etc.) is enhanced by the experience of this course.	4.86

At Texas A&M University in College Station, the seven respondents were also all graduate students with a mix of those who took the course because it was required and those who chose it as an elective.

Students at Texas A&M University – College Station also had the option to provide additional comments. On the "most positive aspects of this course" several students commented on the ability to "know the newest knowledge and to know what the scientists are doing!" "Speakers shared the most updated information—I feel very informed." "The different instructors with different backgrounds made the course very interesting." On "how you would improve this course," students mentioned the need for a textbook or another reference and again mentioned some frustration with the videoconference delivery.

Table 3.
Texas A&M University – College Station Student Evaluation Results

Questions	Rating
I would take another course from this professor.	4.14
The instructor was consistently well prepared and well organized for class.	4.00
The exams/projects were presented and graded fairly.	4.71
Help was readily available for questions and/or homework outside of class.	4.29
The instructor stimulated my interest in the subject.	4.14
The instructor had a thorough knowledge of the subject.	4.29
The instructor kept students informed of their progress	4.43
The instructor treats students with respect.	4.57
Reading assignments and homework contributed positively to the learning experience.	4.57
I learned to apply principles from this course to new situations.	4.57

Discussion of Results

Evaluation data are commonly used in the constant revision, refinement, and improvement of courses. Embracing Farhad Saba's view of a "systems theory of distance education," researchers should consider the complexity of educational research and the use of a variety of data sources. Our attempt to capture the essence of the effectiveness of distance education as a delivery system when teaching complex content to a diverse audience is only scratching the surface! Yet, there are some obvious conclusions and "lessons learned" to help those who are using (or planning to use) distance education delivery systems.

Back to Our Objectives: We wanted students to acquire interdisciplinary knowledge related to the effect of fruits and vegetables on human health. 4 We wanted to make students aware of interdisciplinary career choices and increase their knowledge and understanding of the relationships between research findings and the practical use of phytochemicals. 4 We wanted to use distance education as a dissemination tool for the course content 4 and we wanted to evaluate the effectiveness of distance education as a delivery strategy.4 Student numerical ratings and comments support these findings. This multidisciplinary approach resulted in increased exposure to national expertise and instilled the value of interdisciplinary research. This could only be accomplished with distance education techniques.

Lessons Learned: Students liked the course and learned the material. The "quality" was comparable to on-campus teaching. In fact, there was no difference in comments or numerical ratings at "local" or "remote" sites. Although there were some technical difficulties, distance education was not a barrier to learning.

Things We Will Do Differently: Even with all the training and logistical planning to develop and deliver this course, reliance on presenters to provide appropriate visuals for videoconferencing was a problem. Now that we have the "content" collected, we plan to format correctly for distance education delivery and to develop more Web-based/CD-ROM components to the course. This should help correct many of the transmission difficulties due to videoconferencing to multiple locations. We will use the formative and summative data to revise the course for delivery in 2000.

Implications & Recommendations

Based upon Smith and Dillon's recent article in *The American Journal of Distance Education* (1999), can agricultural educators help define the "prescriptive principles" for effective use of distance education? Here are our recommendations to start this dialog.

METHODS: It is not the *media* that makes the difference, it is the *methods* employed. "Students learning at a distance have the potential to learn just as much and as well as students taught traditionally" (Schlosser & Anderson, 1994). The students enrolled in *Phytochemcials* learned the course material and met the course objectives. This course explored a variety of methods. Our profession needs to determine the *most effective* instructional methods for teaching agricultural content at a distance.

INSTRUCTIONAL DESIGN: This course used a multi-instructor, multi-site, multi-media format. We did not simply apply distance learning technologies to a traditional course (Schrum, 1996). Agricultural educators can help other content areas within our colleges and universities to design distance learning experiences that will maximize learning. We know that *interactive* environments improve retention and transfer. Our profession can be the leader in the design and adoption of student-centered instructional design models appropriate for distance education and other forms of experiential learning.

ASSESSMENT STRATEGIES: The educational evaluation technique, with both numerical means and open-ended responses, provided appropriate feedback for the revision and improvement of this course. By collecting data throughout the course or program, and asking questions that are content specific as well as "technology" specific, researchers are able to separate knowledge/skills acquisition from the distance education delivery system. Our profession needs to develop appropriate evaluation and outcome assessment mechanisms to determine "effectiveness" of delivery strategies.

TEAM APPROACHES: Teaching at a distance takes more preparation/development time and expertise. Our team included the logistical leader (planning the content and speakers), a dissemination specialist (designing the course Web site) and an evaluation specialist (designing and collecting the on-line data). Our profession needs to continue to embrace team approaches. None of us is as smart as all of us.

The most beneficial component of the course was the diversity of speakers/presentations and the relevancy of research applications to undergraduate, graduate, and continuing education students. Only through distance education was this approach possible. The initial evaluative results were useful for the future revision of this course and can be applied to other courses and programs.

References

Borg, W. R. & Gall, M. D. (1989). *Educational research*. New York: Longman.

Campbell, J. R. (1995). *Reclaiming a lost heritage: Land-grant and other higher education initiatives for the twenty-first century*. Ames: Iowa State University Press.

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research, 53*(4), 445-459.

Darby, W. J., Ghalioungi, P. & Grivetti, L. (1977). *Food: The gift of Osiris*. New York, NY: Academic Press.

Doll, R. (1990). An overview of the epidemological evidence linking diet and cancer. *Proceeding of Nutrition Soceity, 49*, 119-131.

Fahey, J. W., Zhang, Y. & Talalay, P. (1997). Broccoli sprouts: An exceptionally rich source of inducers of enzymes that protect against chemical carcinogens. *Proceeding of Nationlal Academic Science 94*, 10367-10372.

Gaziano, J. M., Manson, J. E., Branch, L. G., Colditz, G. A., Willet, W. C., & Buring, J. E. (1995). A prospective study of consumption of carotenoids in fruits and vegetables and decreased cardiovascular mortality in the elderly. *Annals of Epidemiology., 5*(4), 255-260.

Gerster, H. (1997). The potential role of lycopene for human health. *Journal of American College of Nutrition, 16*(2), 109-126.

Glaser B. G. & Strauss, A. L (1967). *The discovery of grounded theory*. Chicago: Aldine.

Hake, R. (1992). Socratic pedagogy in the introductory physics laboratory. *The Physics Teacher, 30*, 546-552.

Hefzallah, I. M. (1990). The educated person. In I. M. Hefzallah (Ed.), *The new learning and telecommunications technologies: Their potential applications in education* (pp. 5-23). Springfield, IL: Charles Thomas.

Hirayama, T. (1985). Diet and cancer: Feasibility and importance of prospective cohort study. In J. V. Jossens, M. J. Hill & J. Geboers, (Eds.), *Diet and human carcinogenesis*. New York: NY: Elsevier Science Publisher (Biomedical Division).

Kohman, E. F. (1947). The chemical components of onion vapors responsible for wound healing qualities. *Science, 106*, 625-627.

Laws, P. W. (1991). Calculus-based physics without lectures. *Physics Today, 44*(12), 112-117.

Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park: CA: Sage.

Morris, D. L., Kritchevsky, S. B., & Davis, C. E. (1994). Serum carotenoids and coronary heart disease: The lipid research clinics coronary primary prevention trial and follow-up study. *Journal of American Medical Association, 272*, 1439-1441.

Munoz, K. A. Krebs-Smith, S. M., Ballard-Barbash, R. & Cleveland, L. E. (1997). Food intakes of US children and adolescents compared with recommendations. *Pediatrics, 100*(3), 323-329.

National Research Council. (1989). *Everybody counts.* Washington, D.C. National Academy of Sciences.

Potter, J. D. & Steinmetz, K. (1996). Vegetables, fruit and phytoestrogens as preventive agents. *IARC Sci Publication, 139*, 61-90.

Russell, T. L. (1996). *The "no significant difference" phenomenon*. Research Reports, Summaries, Papers. Raleigh, NC: Office of Telecommunications, North Carolina State University.

Saba, F. (1999). Toward a systems theory of distance education. *The American Journal of Distance Education, 13*(2), 24-31.

Schlosser, C. A. & Anderson, M. L. (1994). *Distance education: Review of the literature*. Research Institute for Studies in Education. Ames: Iowa State University.

Schrum, L. (March, 1996). Teaching at a distance: Strategies for successful planning and development. *Learning and Leading with Technology*, 30-33.

Seddon, J. M., Ajani, U. A. Sperduto, R. D., Hiller, R., Blair, N., Burton, T. C., Farber, M. D., Gragoudas, E. S., Haller, J., Miller, D. T., Yannuzi, L. A., & Willet, W. (1994). Dietary carotenoids, vitamins A, C, and E, and advanced age-related macular degeneration. *Journal of American Medical Association, 272*, 1413-1420.

See, J. (1994). Technology and outcome-based education: Connections in concept and practice. *The Computing Teacher, 17*(3), 30-31.

Smith, P. L. & Dillon, C. L (1999a). Comparing distance learning and classroom learning: Conceptual considerations. *The American Journal of Distance Education, 13*(2), 6-23.

Smith, P. L & Dillon, C. L. (1999b). Toward a systems theory of distance education: A reaction. *The American Journal of Distance Education, 13*(2), 32-36.

Stake, R. E. (1967). *The countenance of educational evaluation*. Teachers College Record 68, 523-540.

Van Poppel, G. (1993). Carotenoids and cancer: An update with emphasis on human intervention studies. *European Journal of Cancer., 29A*, 1335-1344.