Chapter iii

Literature Scanning
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LITERATURE SCANNING

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3.1 INTRODUCTION

Surveying of related literature in the related field of study is an important process of any type of research. It is mentioned that valuable information on research techniques may be obtained from the previous findings. It is asserted that no experienced researcher would think of understanding research problem without acquainting himself with the contributions of the previous investigators. Although the search for the reference material is a time consuming one, it is a very fruitful phase of research program. The review provides further orientation to the problem, and at the same time, eliminates the possibility of unnecessary duplication of matter.

Scanning the related literature enables the researcher acquire up to date information in the chosen area of study. Familiarity with the previous research and theory in the area of study can help not only in conceptualizing the problem, but also in conducting the study and interpreting the findings.

According to Cooper (1984), “The value of any single study is derived as much from how it fits with and expands on previous work as from the study’s intrinsic properties. If some studies seem more significant than others, it is the piece of the puzzle they solve or they introduce is extremely important, not because they are solutions in and of themselves”. In the words of Merriam (1988), “An investigator who ignores prior research and theory has the chances of pursuing a trivial problem of duplicating a study already done, or repeating others mistakes. The goal of research contributing to the knowledge base of the field may then, never be realized”

An exhaustive survey of the previous research work on the problem is an indispensable step in its solution. It enables the researcher
further probe into the problem in different dimensions, and analyzes all possible ways of arriving at a solution. A survey of literature aims at serving the following purposes:

- To show whether the evidence already available solves the problem adequately without further investigations and thus to avoid the risk of duplication.
- To generate ideas, theories, explanations or hypotheses valuable in formulating the problem.
- To suggest methods of research appropriate to the problem.
- To locate comparative data useful in the interpretation of results.
- To contribute to the general scholarship of the investigator.

In order to gain conceptual clarity of the variables involved in the study and to formulate needed hypotheses for the study, an attempt was made to survey a number of publications such as research journals, books, periodicals, magazines and Encyclopedias. The research studies reviewed were the investigations carried out in India and abroad. The review focuses on the following themes:

2. Plant Taxonomic Database
3. Linnaeus II
4. ETI – Expert Center for Taxonomic Investigation
5. World biodiversity Database
7. Artificial Intelligence and Expert Systems
8. Digital Learning Technology
9. E-learning
Carpenter (1980) reveals that the animation program in Chemistry proves to be effective in teaching the concepts.

Caspers (1981) reviews five science programs for the Minnesota Educational Computing, Odell Lake is a game like simulation of certain aspects of fresh water like ecology. The review indicates the usefulness of the science programs.

Haney (1981) reviews a Chelsea College program on partial scattering. He thinks this is a case where simulation on the microcomputer is ideal. The program used by students to conduct a series of experiments, including one of their own designs, but is not intended to teach everything about partial scattering. Indeed, students are to use the accompanying notes and should answer the questions in them before using the program. The program is pedagogically sound, supporting rather than subverting experiment by students.

Kuznetsov (1986) recommended that CAI should not be compared with traditional instruction on the presumption that one is better or worse than the other.

Clifford (1987) compared the effectiveness of Computer Assisted Instruction in terms of academic achievement and learning retention. Results revealed that no significant differences were found between Chapter I and conventional Chapter I instruction test scores for academic achievement and learning retention.

Miller (1987) compared the effect of different types of computer use on the cognitive abilities of fourth grade students. The results showed that both
the programming and word processing groups scored significantly higher in higher level cognitive skills.

Nelson (1987) sought to determine the effects due to (1) treatment, (2) ability and (3) interaction of treatment and ability that the use of selected mathematics software had on achievement and attitudes of students in college level basic mathematics. Results indicated that there were significant differences in achievement at the 0.05 level in favour of the experimental group in the area of graphs, relations, functions and attitudes.

Tippie Denton (1987) developed a computerized simulation examination to evaluate decision-making in nursing and assessed in terms of its psychometric properties. Planned observations supported the usability of the computerized simulation examination.

Annette (1988) investigated whether the use of Computer Assisted Instruction at the reinforcement stage of instruction would be effective in meeting individual needs of time on task and allow students to be successful in the acquisition of music reading skills. Results indicated that Computer Assisted Instruction used to reinforce lessons in music reading skills more effectively than traditional group reinforce methods.

Ariene et. al. (1988) examined the effect of additional mathematics practice with the microcomputer. The results indicated that the pictorial mode might be the most effective. A significant superiority for the pictorial mode of presentation was observed.

George (1988) evaluated the effect of computer delivered science simulations on the achievement of science process skills with fourth and fifth graders. The results revealed that the treatment group membership, gifted
group membership, and hours of simulation use made statistically significant contributions to the prediction of post test score.

Nancy Patricia (1988) studied whether elementary school teachers would incorporate effective academic verbal feedback behaviors into their teaching when these strategies were presented to them by means of microcomputer simulations. It was found that the treatment had no observable effect on teacher behavior.

Shantha (1988) developed a software to motivate and for the understanding of some simple but key probabilistic concepts with the idea of simulations. The results indicate that students enjoy this novel approach exploring random events. An analysis of student outcomes revealed that students understood the basic probabilistic concepts involved in the study. The use of real-life applications particularly seemed to motivate students' interest and aid them in understanding the subject matter.

Peterson (1989) developed a new kind of computer simulation and explored its impact on teaching and learning on introductory biology. It was found that some of the computer graphics and software design of the simulation components were effective even though they were more complex than traditional modeling techniques, and that existing artificial intelligence models need to be further developed before they can be used in programmed tutoring for science instruction. Videotaped protocols of pairs of students exploring the software using written directions proved to be valuable formative evaluation techniques.

Holland (1990) designed a training program to prepare disabled adults for jobs in the personal computer (PC) industry. At the end of the case study, it was seen that the Business PC Specialist program has been very successful
in placing disabled adults in jobs in the PC industry. The curriculum changed significantly over the two year period of the case study. After the training programme, the trainees displayed self-confidence in linking new ideas with prior learned concepts as disclosed in their graduation sentiments.

Richard Stead (1990) examined the way in which students learn from a computer based simulation in economics. He noticed popularity of such simulations and the relative lack of information about their contribution to students' learning.

Rodgers Robert (1990) discusses changes in educational content and methodology brought about in response to the needs of the present technology-driven information age. The use of word processing, databases, and spreadsheets is explained in relation to the promotion of higher order thinking skills. The increased amount and graphic nature of information as well as the increased role of the media center are discussed.

The study of Terrell Nelms (1990) indicated the effectiveness of computer simulation to facilitate the ability of subjects to generate and test hypothesis.

Birnbaum Lawrence (1991) examined the papers presented at the fifth International Conference on the Learning Sciences (formerly the International Conference on Artificial Intelligence and Education). As the change in name signifies, a strong effort has been made to open the conference to a broader audience, including educational and cognitive psychologists interested in the problems of teaching and learning, and software designers interested in building systems to facilitate teaching and learning. The issues involved in artificial intelligence (AI) and education are of interest to a broad spectrum of researchers in education, psychology, and software systems. As in previous
years, there are papers on tools and authoring systems, teaching architecture, student modelling, interfaces, simulation, and empirical evaluation. Science education, especially biology, mathematics, and physics, receives attention, as do language and writing skills. Problems of corporate and industrial training are also addressed. Cooperative and collaborative learning involving groups of students is an important theme of many papers. Questioning and storytelling which are taken as central to teaching and learning, contribute to the development and use of cognitive strategies. A number of papers address the question of how computer systems can aid teachers in such tasks as lesson planning. Finally, interactive video and hypermedia systems continue to grow in importance.

Hung Jen (1991) aimed at finding out the current status of computer use and existence of computer networks used in industrial education. The results indicated the differences between current and ideal numbers of computers and network equipment in technical institutions.

Jennifer (1991) studied whether or not there would be a relationship between the use of multimedia and the development of higher level thinking skills in a group of seventh grade students who had multimedia infused into the curriculum during the sixth and seventh grades. Results indicated that there was no significant difference between the two groups in improvement of higher level thinking skills over the period. However, the experimental group improved significantly among all phases of testing, with the greatest increase occurring between II and I.

Krisana (1991) investigated the color preferences of Thai and American students for text and background computer color combinations. There were no significant differences in the color preference among age groups of Thai students. The Thai and American students' computer color combination
preferences were virtually identical. The preferred color combination was a white text with a blue background. The students also preferred white, yellow and green text with black background, and black text with yellow background.

William Rallie (1991) studied whether the implementation of a specific GAI model-GGG was effective for remediation reading. The study revealed the positive result.

Anette Mae (1992) studied different effects of computer based simulations on student performance. Simulations made the study of computer architecture more concrete. The students commented on some of the design aspects and unhesitatingly recommended their continued use.

Vickie Marie (1992) found that the treatment with animation has increased conceptual understanding of the learners.

Anne Lucas (1993) established correlation between the current status of computer integration into home economics education and variables affecting integration. It was found that the general status of computer integration in the home economics education units is at partial or mid integration level, where computer use is expected, but not necessarily integrated into home economics education courses. Faculty was more likely than administrators to report at the non-implementation levels.

Clareann (1993) studied how multimedia CD-ROM technology enables learners actively to engage more of their senses in the learning process as well as to develop their information searching skills and strategies. The conclusions of the study are: As a user-friendly means of acquiring information, multimedia CD-ROMs have exciting potential. However, for effective learning and research to be conducted in this field, the learners
should be involved in purposeful learning, most important they must be given appropriate instruction with regard to searching and ample time to navigate through such resources.

Lajoie et al. (1993) provide exemplars of the types of computer-based learning environments represented by the theoretical camps within the field and the practical applications of the theories. The contributors discuss a variety of computer applications to learning, ranging from school-related topics such as geometry, algebra, biology, history, physics, and writing, to the more technical domains of electronics and avionics.

Milhein (1993) undertook a research on the effectiveness of animation as an instructional tool. It is concluded that given the current number of high quality animation software packages, it is becoming increasingly easy to develop computer-based training and multimedia materials that include a significant animation component.

Mohammed Mehdi (1993) studied the effective method of presenting instruction in engineering design graphics. The analysis of the results revealed that the group that received instruction via animation performed generally better on the retention, quizzes, and assignments than the static group.

Un Ching (1993) investigated whether differences in the level of visual complexity in motion visuals have an effect on cognitive learning of students in different grade levels. The results of this study indicated that providing different levels of visual complexity in motion visuals had no significant impact on children's comprehension of the intended learning.

Chul-Hwan (1994) investigated the effectiveness of auditory cueing of interactive multimedia material and cognitive style across the dependent
measures of reading comprehension achievement scores, incorrect tries, and time spent in completing lessons. The positive effect of multimedia has been proved.

Daniel Glen (1994) investigated the relationship between student learning style (aptitude) and student outcomes with Computer Assisted Instruction (treatment). It was concluded that learning style is an inadequate measure of factor related to aptitude for Computer Assisted Instruction.

Gary et. al. (1994) investigated the use of interactive multimedia language learning material within a classroom. The study demonstrated the significant role of a whole and cohesive learning environment in which the teacher, students, and computer interacted together so that the students could have independent and responsible learning environment.

Perzylo et. al. (1994) undertook a descriptive study of two individual classes in two separate independent schools, the Dalton School and the Bank Street School for children. The Dalton prototype, Playbill, was developed for a tenth grade class studying Mac Beth, and the Bank Street School for children prototype, Family Stories was developed for a seventh grade class studying American immigration. Each prototype was developed in hyper card for Macintosh computers and was implemented during an eight-week curriculum unit. A comparative analysis of both cases provides insight into the conditions necessary for integrating technology in classrooms.

Janet et. al. (1995) explore the meaning of computer technology in schools. Students used artificially intelligent tutors; business classes in which students learned word processing; and computer science classes in which students learned programming. In addition, two dozen teachers and 250 students were interviewed.
Keith Douglas (1995) examined the effects that varying levels of visual complexity of computer animation presentations. Three computer-based instruction tutorials (realistic animation, symbolic animation and implied animation) were developed to teach proprietary transportation routing methods to adult learners. The results of this study showed no significant interaction existed between the level of visual complexity of computer animation and the subjects’ level of field dependence. Subjects receiving the realistic animation scored higher than subjects taking the symbolic animation and implied animation treatments.

Leslie et. al. (1995) explored the effects of multimedia literacy tool (MLT) on first grade reading and writing achievement. The study concludes that the MLT can selectively be a powerful tool for enhancing reading and writing in young learners.

Patricia (1995) examined the utilization of multimedia computer technology in corporate training and development programs. The results were: In categories of resources of facilities and the level of knowledge of multimedia computer technology required of corporate training and development professionals, the experts agreed that multimedia classrooms, lecture support system, media access room, distance learning systems, virtual reality laboratories and the knowledge regarding the acquisition of multimedia computer technology, should be used in corporate training and development programs in the future.

Sajit (1995) examined the effects of multimedia based instruction on undergraduate students' academic performance in economics. The results revealed that the level of significance was at 0.05 level. Significant effects were found in the academic performance of students and students' liking towards economics.
Sharon Cody (1995) found that the teachers described Computer Assisted Instruction as another tool that could supplant some of the paper-and-pencil work associated with learning to read. Eclectic and constructionist teachers were more flexible about computer time and student’s choice of software than didactic teachers.

Siribonthi (1995) studied the effects of three different formats of interactive multimedia. The results revealed that there were no significant mean differences among the three conditions.

Atkins et. al. (1996) investigated the cognitive impact of three different types of multimedia simulation (physical, procedural and process) for teaching the concept of energy to 14 year old students. The results revealed the gain of cognition from three simulations.

Amal Mustafa (1996) found that the subjects exposed to the animated visual graphics performed better on three learning tasks.

David et. al. (1996) examined an innovative multimedia facility created in partnership with the New Media Center's consortium, which is a partnership between technology corporations and institutes of higher education. Findings include the discovery that the facility was itself an innovation created in response to the innovation of multimedia technology.

Kaye et. al. (1996) investigated the feasibility of developing templates and template materials for educators to design instructional multimedia modules using the software language, Visual Basic. Two types of instructional aids were developed to resolve their problem, templates and training materials. The aids were created to focus on the syntax of the tool and also on the supporting tools and strategies necessary to design and develop effective
multimedia software for the classroom. Templates, based on sound educational characteristics of multimedia, were developed and used in conjunction with Visual Basic. Materials were developed to train an educator to use Visual Basic and the set of templates to create an effective educational multimedia module.

Robert (1996) analyzed the computer mediated learning in elementary school science. The results revealed that computer mediated learning offers specific benefits, but it must not be used as an application-purpose tool. Instead, computers must be used judiciously, supporting formal dimensions of knowledge while not excluding the tacit.

Simerly (1996) offers guidelines for integrating technology-enhanced education into the curricula: (1) support faculty and administration in developing technology-enhanced education; (2) identify information technology skills that graduates will need; (3) assist in planning support systems; (4) work with stakeholders to develop realistic estimates of needed resources; and (5) align student services to provide support.

Sookyoung (1996) investigated the effect of animation in the enhancement of the problem solving and retention of scientific concepts in computer based modules across learners possessing different cognitive styles. Participants receiving an animation treatment performed significantly better than those receiving a static visual treatment on problem solving but not on recall.

Willem Jam (1996) studied the effectiveness of Multimedia computer program in a pre-training session. Analysis of results from pre-and post-psychomotor data indicated no significant statistical difference between the control and experimental groups as a function of the type of pre-training.
William (1996) studied the impact of IMT on broadcast education over the next three years at 4-year colleges and universities in the United States. Key findings included: (1) Interactive multimedia technologies are very likely to result in broadcast education curriculum reform at both the undergraduate and graduate levels. (2) Instructional applications of IMT in broadcast education would likely be limited over the next 3 years with the most probable applications in the teaching of video production. (3) Broadcast researchers are most likely to focus on the impact of IMT on other media and the uses and gratifications served by interactive multimedia technologies. (4) Obstacles to the implementation of IMT would include equipment, funding, qualified faculty, and competition from other departments within the University.

Anne Lumpkin (1997) studied whether computer based multimedia lecture presentations could affect Community College microbiology students' achievement, attitudes toward learning microbiology, and retention when compared with traditional lectures. Student responses showed positive attitudes toward the multimedia presentations. These findings indicate that incorporating multimedia lecture presentations into the microbiology classroom contributes to improved student satisfaction as shown by significantly more positive attitudes toward learning microbiology with the computer based multimedia lecture presentation when compared with traditional lectures.

Baxter (1997) compares a multimedia package for teaching about the phases of the moon to grade 8 (12-year-old) students with a conventional three-dimensional modeling approach. Results show both methods were equally effective in terms of student learning, for male and female students, and prior computer experience was not a factor in multimedia use.

Hongwen et. al. (1997) discuss the main features of hypermedia and its significance in the application to education. Highlights include multimedia
teaching materials; interaction; convenience in storing and using information; problem solving and critical thinking; individuality in study; and the design of nodes and links in hypermedia.

Jones et. al. (1997) describe "Wytz's Playground", a fourth grade math multimedia title that emulates and simulates the real-life scenario of building a playground and supports the instruction of mathematics and measures proficiency in five NCTM (National Council of Teachers of Mathematics) standards. Explain the multimedia production process and the mathematical model.

Kozma (1997) examines how professional chemists and undergraduate chemistry students respond to chemistry-related video segments, graphs, animations, and equations. Discusses the role that surface features of representations play in the understanding of chemistry.

Laura Lee (1997) designed an experimentation to identify gender differences in learning using animation and graphics. Results showed that animation significantly improved women's long-term learning over static graphics.

Petersen Rodney (1997) argues that science and technology associated with research in artificial intelligence, the Human Genome Project, cosmology, and sociobiology raise questions that promote dialogue between the world of science and religion.

Roxana (1997) examined the use of a number line metaphor presented with interactive multimedia to help learners with varying levels of mathematics achievement or spatial ability build connections between addition and subtraction of signed numbers and existing conceptual knowledge. Results
indicated that use of multiple representations benefited students with high achievement/ability more than students with low achievement/ability.

Sanda et. al. (1997) review the literature on legal information systems/CALR (computer-assisted legal research) and law office automation, including legal expert systems and information technology applications relevant to legal education and courts. The new phenomenon of Internet use in the field of law is also discussed. Describes Dean Kamen's FIRST foundation (For Inspiration and Recognition of Science and Technology) and its sporting competition that offers high school students hands-on acquaintance with robots of their own creation; its goal is to inspire students to pursue future studies in science and technology by showing them that learning in this area can be fun, exciting, and important.

Sean Snydar (1997) explains how the Boeing Company has used the World Wide Web to deliver flight and maintenance computer-based training (CBT) that was originally created on a Macintosh computer and converted to Windows format. The solutions described confirm that, with improvements to Authorware and the appropriate hardware infrastructure, it is fairly easy to achieve CD-ROM-quality courseware in an Intranet environment.

Abbas (1998) examined the effects of two inductive multimedia programs, on including graphs, on subjects' ability to create linear functions and conceptualize variables from word problems. Students scored significantly higher on the post test than on the pre-tests on both function construction and variable conceptualization.

Chapelle (1998) suggests that some design features and evaluation criteria for multimedia computer assisted language learning (CALL) might be developed on the basis of hypotheses about ideal conditions for second
language acquisition (SLA). Outlines a relevant theory of SLA and enumerates the hypotheses it implies for ideal conditions such as input saliency, opportunities for interaction, and learner focus on communication.

Fenton (1998) proposes that high school choir teachers utilize multimedia technology in order to provide students with simultaneous aural and visual examples of various musical concepts. Offers examples using a multimedia approach to teach John Bennet's "Weep, O Mine Eyes" and Randall Thompson's "The Road Not Taken." Includes a list for selected softwares.

Geoff et. al. (1998) give a brief outline of the development of Artificial Intelligence in Education (AIED) which includes psychology, education, cognitive science, computer science, and artificial intelligence. Highlights include learning environments; learner modeling; a situated approach to learning; and current examples of AIED research.

Gerald et. al. (1998) examined a case study, the process of installing and implementing a multimedia technology education laboratory at a Mid-Atlantic High School. The project was undertaken to include a course in foundations of technology at the high school level. The process of installing and implementing a technology education laboratory described in this study may serve as a guide for those who wish to undertake a similar project.

Jeff et. al. (1998) describe a range of computer assisted learning software models--linear, unstructured, and ideal--and discusses issues such as control, interactivity, and ease-of-programming. It also introduces a "compromise model" used for a package currently under development at the Hong Kong Polytechnic University, which is intended to teach students principles of molecular biology.
Kristan et. al. (1998) studied the impact of multimedia presentations and GSSs on various aspects of teaching and learning. The results of the study indicate that no significant differences exist between students exposed to the experimental treatments and students in the control group regarding performance, satisfaction, or perceived understanding.

Linda et. al. (1998) present easy-to-implement strategies for increasing learner autonomy by embedding teacher functions within the World Wide Web-based graphical user interface (GUI). The embedded teacher (ET) model proposed in this paper is similar to the butler model, which describes a good interface as performing many of the roles of a good butler (e.g., helping a person enter, exit, and move from room to room). The ET model combines the butler model with core and complementary information zones by recommending that four overall teacher functions be embedded into a GUI: (1) orienting the learner; (2) providing navigational assistance; (3) providing instructional strategies; and (4) providing interactive feedback. Altogether these four elements work to perform the essential tasks of a live teacher.

Long Dee (1998) analyzed the impact of multimedia software on cognition, to determine the attributes of multimedia software that support cognition. The study revealed that the features and the design of the software limited the learner's level of cognition. The impact of the software on cognition was varied and the features and the design of the software limited the students' cognition.

Michael et. al. (1998) analysed the design and deliver educational applications of digital learning media and to identify criteria for assessment of the efficacy and quality of the use of such media from a comparative analysis of three credit-bearing courses delivered in both on-line and conventional modes of delivery. The design principles for production of educational
applications of digital multimedia are outlined. The study revealed the effectiveness of digital media.

Newman Richard (1998) investigates how different types of achievement goals influence elementary school students' help seeking. Goals were conceptualized on two dimensions: locus of the goal (i.e., personal goals and contextual goals) and emphasis of the goal (i.e., learning goals and performance goals). Interactions among goals and their resultant patterns of help seeking are discussed.

Richard John (1998) investigated instances in which the creation of student-generated, multimedia works (i.e., the combination of sounds, visuals, and text) helped to realize arts-integrated, educational strategies. It was concluded that this research would be formative rather than summative; inductive rather than deductive. It sought to answer questions about the quality of what was taking place. This study would offer a sort of prismatic view of the use of multimedia in arts integrated curricula.

Rowe Neil (1998) describes an intelligent tutor incorporating a program using artificial intelligence planning methods to generate realistic audit files reporting actions of simulated users and intruders of a UNIX system, and a program simulating the system afterwards that asks students to inspect the audit and fix problems. Experiments show that students using the tutor learn quickly.

Ruddy et. al. (1998) show how education has successively benefited from traditional information processing through programmed instruction and computer-assisted instruction (CAI), artificial intelligence, intelligent CAI, intelligent tutoring systems, and hypermedia techniques.
Steve et. al. (1998) study the taxonomy that categorizes intelligent agents by the degree of intelligence embedded in the software. Applications of today's intelligent agents are discussed, including specific examples of the following: (1) agents that watch, i.e., look for specific information or events; (2) agents that can learn from observing users' behavior; (3) agents that can retrieve, which are capable of searching for information in an intelligent fashion; (4) agents that can assist in specific tasks; (5) agents that can converse with the user; (6) agents that can collaborate, providing assistance in several areas related to collaboration; and (7) agents that can do comparison shopping. World Wide Web addresses for the agents described are listed.

Viall (1998) provides a background of the development of hypermedia technology and describes a hypermedia system that could be used to teach probability and statistics through a web-based interface.

Westhoff Dirk (1998) presents "Campus," an environment that allows University of Hagen (Germany) students to connect briefly to the Internet but remain represented by personalized, autonomous agents that can fulfill a variety of information, communication, planning, and cooperation tasks. A brief survey is presented of existing mobile agent system environments, all of which are based on a central architecture requiring one or more servers to be permanently active and reachable.

Bruce et. al. (1999) examines the relationship between higher education and corporate business in North America, culminating in what is coming to be called the E-Learning Corporation, a new and closer interaction that has enormous potential benefit for institutions and for society in general. Discussion highlights include higher education and society as adversary; the corporation as client; the corporation as competitor; the corporation as partner; and the rise of adult distance learning.
Buckley Donald (1999) reports on research that used the development of interactive multimedia learning environments as a device to allow faculty to explore principles of the Learning Paradigm. The pedagogical feature set of this technology that resonated with faculty and that can foster transition to the Learning Paradigm is presented.

Buiu Catalin’s (1999) review contains an overview of past and present trends in the application of what is called “artificial intelligence” in traditional face-to-face education and in distance education. The reviewed trends are illustrated with examples of research projects and results throughout the world. The first section of the review discusses intelligence in general, describing classic and modern theories of intelligence. Definitions of artificial intelligence in education are presented, with attention to these areas: (1) intelligent tutoring systems; (2) interactive learning environments; (3) virtual environments for education; (4) computer-mediated communication; (5) intelligent agents for education; (6) the World Wide Web and education; and (7) intelligent interfaces for learning support systems. Perspectives for the future of artificial intelligence in education are discussed.

Chen His (1999) discusses the need for semantic research in digital libraries to help overcome interoperability problems. Highlights include federal initiatives; semantic analysis; knowledge representations; human-computer interactions and information visualization; and the University of Illinois DLI (Digital Libraries Initiative) project through partnership with the Artificial Intelligence Lab at the University of Arizona.

Donald et. al. (1999) make a current assessment of the philosophy of instructional technology using a 1970 "British Journal of Educational Technology" (BJET) article as the basis of comparison. Discusses the
influence of distance education, public acceptance of media and technology, and training by artificial intelligence in business and industry.

**Doyle** (1999) provides information for establishing multimedia standards for university classrooms based on experiences at Harvard University. Includes descriptions of standards for items ranging from assistive listening systems with related ADA (Americans with Disabilities) requirements to projectors, and encourages the establishment of standards based on specific pedagogical needs of the individual institution.

**Gregory** (1999) presents information on several critical themes related to multimedia instruction for those involved in the design, development, or use of computer delivered instruction. Addresses software product life cycle; systematic approach to design; multimedia design and development teams; production values; critical components of effective multimedia; learner motivation; and continuous evaluation.

**Grimley et. al.** (1999) assessed the effectiveness of CD-ROM multimedia packages on science topics. The study ended in positive results.

**Hirschbuhl** (1999) found the effectiveness of Interactive Multimedia instruction upon the variables of achievement and problem solving skills on non-science majors in an Environmental Science course at a Mid-Western University.

**Howard et. al.** (1999) describe and discuss how simulation activities can be used in teacher education to augment the traditional field-experience approach, focusing on artificial intelligence, virtual reality, and intelligent tutoring systems. Includes an overview of simulation as a teaching and
learning strategy and specific examples of high technology simulations in development and in use.

Lian Sai (1999) provides insights gained into some practical design considerations in developing a multimedia courseware in chemical education at secondary school level. It concentrates on the early stage of the development process and specific design tips or guidelines based on practical pedagogical experiences in courseware design and storyboard.

Maor (1999) describes a professional development program using interactive multimedia workshops to develop teachers' understanding of a constructivist epistemology in science education. Discusses teachers' perceptions; how they changed their classroom practices; software and database development; and the development of a new survey to assess reactions to their experiences.

Martin Stewart (1999) reports that the development of interactive multimedia learning environments serves as a device to allow faculty to explore principles of the Learning Paradigm. The pedagogical feature set of this technology that resonated with faculty and that can foster transition to the Learning Paradigm is presented.

Nigel et. al. (1999) describe implications of emerging initiatives and possible system improvements for the Schools Advisory Group stakeholders and the broader education community; and make recommendations for common technical approaches amongst the SAG stakeholders in relation to information management techniques.

Orazio et. al. (1999) explore a new educational application of Piaget's theories of cognitive development: the use, as a teaching tool, of physical
robots conceived as artificial organisms. The study reviews educational projects using real robots. It shows that the use of intelligent systems to enlarge the view of biological reality could become an integral part of curricula in science, technology, psychology, and biology.

**Rillero Peter** (1999) describes open-ended experiments with seeds from the common garden radish (Raphanus sativus). The phases of the 5-E learning cycle—Engagement, Exploration, Explanation, Extension, and Evaluation—guide this activity series.

**Tim et. al.** (1999) argue that the first phase of the Web is communication through shared knowledge. Predicts that the second side to the Web, yet to emerge, is that of machine understandable information, with humans providing the inspiration and the intuition.

**Aldrich Clark** (2000) explains the factors driving the trend toward customer-focused electronic learning (CFEL) include the increased sophistication of products and services, the need to reduce the customer training burden, and the need to bolster revenues. CFEL can shift training from a support role to a marketing tool and a profit center.

**Barron Tom** (2000) maintains that the decision makers often turn electronic learning over to the information technology (IT) department; external hosting is a viable option if IT departments are overwhelmed. Trainers can aggressively promote implementation of e-learning by partnering with in-house departments including IT.

**Bereiter Carl** (2000) discusses two models of the mind: the influential model of "mind as container," in which the mind is akin to a computer storing data; and a connectionist model, in which the brain does not actually store or
contain knowledge in the sense traditionally believed. Discusses the second model's implications for education.

Cathy et. al. (2000) observes that every computer for student use should have software for multimedia production. All students should be using high-quality Internet resources in core content learning. The Global School Network can help teachers become part of Internet-based exchange projects. Teachers are key to integrating technology with classroom curricula.

Dobbs Kevin (2000) presents that like dot.com businesses, electronic learning ventures in the training industry are experiencing a shakeout. Those that survive must focus on providing compelling, innovative programs with enticing learning material that would keep people online.

Dobbs Kevin (2000) suggests that training on the Web, or e-learning, falls short of its promises. Offers an agenda for improvement: (1) stop pretending that reading is training; (2) increase bandwidth; (3) adopt interoperability standards; and (4) conduct internal and external evaluations of web-based training.

Doyle Mary (2000) explores topics related to the future of information technology and strategic, academic, resource, and facilities planning in institutions of higher education. It was found that technology had a greater impact on Institutional Planning, Cycles in Curriculum Planning, College Curriculum Life Cycle, Campus Digital Plan, Planning for IT in Higher Education is analyzed.

Evers Colin (2000) provides a detailed, technical introduction to the state of cognitive science research, in particular the rise of the "new cognitive science," especially artificial neural net (ANN) models. Explains one influential
ANN model and describes diverse applications and their implications for education.

Felder (2000) maintains that universities that specialize in distance education are using multimedia courseware and the Internet effectively, and the quality of their offerings is gaining increased recognition. Speculates on the future of technology in higher education and the continuing need for gifted professors.

Galagan Patricia (2000) observes that electronic learning has made knowledge accessible to a large number of people and is challenging training's basic tenets. Traditional training would persist, but not as a growth sector. The rise of e-learning divides training into corporate learning and training for strategic purposes.

Graves William (2000) describes some of the dimensions of the "ecology" of Internet-based "e-Learning" in higher education. Discusses e-Learning service and operating dimensions; higher education's challenge to balance virtual and traditional educational delivery; instructor-led and instructor-less learning; the roles of content and instructor in instructor-led learning; the role of the instructor in instructor-led e-Learning; and shifting to learner-centric instruction.

Hain Patricia (2000) examines the effect of hypertext and animation in the context of online learning. With an increasing number of online courses and degrees offered through the Internet and a rapidly increasing enrollment in such courses, it is important to assess and understand how these online features can affect or contribute toward learning. The paper proposes and tests a model to explain and predict the effect of hypertext and animation on online learning. Preliminary results of the study are reported.
Hall Richard (2000) explains the "Issues in Courseware Reuse for a Web-Based Information System"; "The Digital Curriculum Database; A Web-Based Program To Improve Fluency in Information Technology at UNB"; "Pedagogical Issues in Web-Based Learning: The Digital Learning Interactive Approach"; "Higher Learning Online: Using Constructivist Principles To Design Effective Asynchronous Discussion"; and "A Model of Faculty and Course Development for Distance Education".

Howard et. al. (2000) while analyzing multiple intelligence disagree about the role theory of knowledge in the context of justification of multiple intelligence. Specifically, asserts that the article's criticisms based on philosophy of science claims and work with artificial neural networks do not approach the real heart of the theory.

Kevin (2000) discusses how the Internet not only changes the way training can be delivered but it changes the way companies decide who gets trained to do what. Looks at what Web-based training has done for a number of companies and discusses pitfalls and roadblocks.

Khan Badrul (2000) discusses the growing demand for online learning activities; considers the possibilities that the Internet offers for a flexible learning environment; and describes a framework for electronic learning that addresses institutional, pedagogical, technological, interface design, evaluation, management, resource support, and ethical issues.

Leventhal et.al. (2000) discuss whether computer-based instructional materials improve student learning. It also evaluates a computer-based hypermedia tutorial that was delivered over a web site. The study proves effectiveness of both the approaches.
Lewis Nancy (2000) points out that knowing learner preferences can inform instructional design, but may not produce effective online learning. Five attributes that are strong predictors of an innovation's effectiveness should also be considered: relative advantage, compatibility, complexity, trialability, and observability.

Marlon et. al. (2000) present a three year case study of the conceptualization, design, funding, construction, and the installation and implementation of instructional systems for an instructional facility built in renovated office space at Syracuse University's School of Information Studies. The Digital Learning Center is a 48-seat technology classroom with distance education and corporate presentation elements.

Moonen Jef (2000) discusses the change in learning materials to digital formats and considers whether current design and production methods for educational software are still appropriate or if there is a need for a new design and production strategy. Describes structural versus associative design strategies and a new three-space strategy.

Mustapha Ramlee (2000) explains that the development of information technology and the Multimedia Super Corridor (MSC) project has placed Malaysia within the global interconnectivity along with other developed nations. Types of IT applications are e-learning, e-mail, discussion group mailing lists, bulletin board systems, chat mode, newsgroups, Internet, tutorial, hypermedia, and file transfer protocol.

Paul Sweller (2000) shows that the diagram-only presentation was the least intelligible, but after two specifically designed training sessions, the advantage of the visual diagram-auditory text method disappeared. In a
second study, the opposite was true; the diagram-only group outperformed the audio-text group.

Peters Otto (2000) maintains that new ways of teaching online allow integration of different presentation methods, multisensory instruction, extensive interactivity, and improved support systems. The digital environment makes autonomous learning even more autonomous. There is a shift from instruction to enablement of independent and self-directed learning.

Ronald et. al. (2000) describe the Digital Learning Interactive textbook which allows instructors to customize an online textbook to meet the needs of the instructor and the students. Discusses the features and components aimed at engaging students in the Digital Learning Interactive text.

Roxana (2000) discusses two studies that explored whether adding music and/or sounds to multimedia instructional messages would improve the quality of college students' retention and transfer. Groups receiving both music and sounds performed worse than groups with neither. Students receiving sound only performed worse than groups not receiving sound.

Sharon et. al. (2000) explain that the Teacher Professional Development Institute employs Internet technology to support distributed professional learning communities. The Secondary Teacher Education Program (STEP) at the University of Wisconsin-Madison will soon employ a similar model in its program. Work and learning within STEP evolves around instructional design teams comprising pre-service teachers and various advisors.

Sillitto (2000) describes the development of Simple Projectiles Lesson And Test (SPLAT), an interactive multimedia presentation that targets students
aged 16 and older and focuses on teaching the fundamental concepts of physics with a simple and exciting approach, and filling in the gaps of school physics curriculum. The validity of the software was established.

**Stephen et. al. (2000)** investigate the interaction between teaching technique (multimedia versus traditional teaching approaches) and student learning styles (verbally- and visually-oriented students) to demonstrate that individual differences moderate the impact of multimedia approaches on student learning. The study suggests that multimedia benefits students with a high visual orientation.

**Thomas et. al. (2000)** observe that today's "digital child" has never known a time bereft of computers, change, or easy communication systems. Computers and other technologies have irreversibly transformed kids' learning environment, temperament, and conceptions of work and play time, relationships, location, technological advancement, relevant knowledge, and flexibility.

**Alexander et. al. (2001)** explains that with the growth of online courses available for K-12 education, administrators should consider the following advice before implementing them in their schools: Plan carefully; think education, not technology; cooperate, do not compete; figure out the money. Includes a list of print and online reference materials on K-12 online education.

**Andrew Malcolm (2001)** observes that a Web-based learning can provide a platform for achieving this in a variety of ways other than the simple provision of "flat" lecture notes. It also describes a number of Web-based programs used to augment, rather than replace, traditional, face-to-face delivery of a pharmaceutical microbiology module to second year undergraduates on a 4-year course.
Antoine Clarke (2001) describes the emergence of corporate universities and strategic alliances among universities, electronic learning companies, and technology companies that are providing online delivery of interactive education and training. Outlines characteristics of comprehensive electronic learning and cautions against the use of new technologies to deliver relatively routine training.

Antonia et. al. (2001) made attempts to motivate students who are beginners in literature through multimedia formats, including video, audio books, CD-ROMs, CDs, slides, and a teacher-made Web site, ALELA: Poetry. Multiple intelligences are integrated into this process. Teachers and students use multimedia materials in many ways to teach and learn poetry.

Boss Richard (2001) describes and defines the various components of an expert system, e.g., a computerized tool designed to enhance the quality and availability of knowledge required by decision makers. It is noted that expert systems differ from conventional applications software in the following areas: (1) the existence of the expert systems shell, or interpreter; (2) the presence of a "knowledge base," or system of related concepts that enables the computer to approximate human judgment; and (3) the sophistication of the user interface.

Coyne et.al. (2001) evaluate the concepts from universal design in architecture that are applied for development of educational curricula and materials that include supports for access for a range of students including those with disabilities. This article traces the development of Universal Design for Learning (UDL) and describes a project that developed both a model digital U.S. history textbook incorporating UDL features and publisher guidelines.
David et. al. (2001) investigated statistical methods for identifying errors in Bayesian networks (BN) with latent variables, as found in intelligent cognitive assessments. BN, commonly used in artificial intelligence systems, are promising mechanisms for scoring constructed-response examinations.

Douglas et. al. (2001) examines how the use of server-based courseware development solutions affects the instructional design process when creating online distance education. Highlights include pedagogical, visual interface (e.g., visual metaphor and navigation layout), interaction, and instructional design implications of online courseware.

Fathaigh Mairtin (2001) explains that the new e-learning technologies offer rich promise and potential of learning delivery at any time, anywhere, on any topic. Without careful management of the learning process, application of best principles and practices in e-learning design strategies, effective attention to staff development, provision of extensive learner support services, and careful focus on a range of socio-educational issues, the promise may lead to a widening gap in access between rich and poor, young and old, employed and unemployed, and computer literate and illiterate persons. Access to e-learning may actually be made more difficult by the wider use of technology claimed to be able to improve it.

Finley (2001) discusses two collaborative efforts of classroom and computer teachers to integrate adapted technology into the elementary and secondary curriculum of 24 students with visual impairment. In the primary level, project students developed computer Internet and word processing skills while studying desert life. In the secondary-level, project students developed research, software, Internet, and alternative media skills while studying earthquakes.
Fry Kate (2001) describes the rise of electronic learning, size of the market, and activities of provider organizations. Depicts the wide range of providers and alliances that are emerging and discusses the need for evaluation measures and quality benchmarks.

Gibson David (2001) describes the development of an interoperable metadata base system—a system of applications using metadata—that is intended to facilitate learner-centered collaboration, access to learning resources, and the fitness of channels of information to the emerging needs of learners at both individual and group levels. Highlights include: self assembly approaches in artificial intelligence; definition of several relevant concepts, e.g., elements/paths, fitness functions, recombination, and feed forward/feedback paths; and types of metadata, e.g., audience, discipline, and theme. The new World Wide Web-based educational database applications are preparing to use the concepts of self-assembly to treat digital media paths as a new form of texts and courses in education.

Henry Paul (2001) observes that electronic learning involves a holistic approach independent of courses, technologies, or infrastructure. The approach includes integrated learning paths that vary according to student, content, level of competence, and preferences.

Johannsen et. al. (2001) describe a case study of an experience with e-learning, compared with traditional lecture-based learning, at the Copenhagen Business School. The study suggests that this problem-oriented and dialogue-based approach may hold substantial potential in international business education.

Julie et. al. (2001) examine how predictive modeling can be used to study application behavior. A relatively new technique, artificial neural
networks (ANNs), was applied to help predict which students were likely to get into a large Research I university. Data were obtained from a university in Iowa. Two cohorts were used, each containing approximately 20,000 records.

Judy et. al. (2001) discuss the digital versions of traditional curricular material notes and the ways they effectively reduce barriers to learning for students with a variety of disabilities. Testimony before a Senate committee by David Rose, from the Center for Applied Special Technology and the National Center for Accessing the General Curriculum, urges passage of the Instructional Materials Accessibility Act of 2001.

Lancaster et. al. (2001) examines enough familiarity with developments in artificial intelligence and related technologies to be able to advise the information service community on what can be applied today and what one might reasonably expect to be applicable to library and information services in the near future. The emphasis is on systems that are actually operational now--systems that have been incorporated into an everyday working situation rather than those that are at experimental or prototype stages. In assessing the relevance of technologies, particular attention was paid to applicability in a digital library environment.

Lawrence et. al. (2001) describe the development of a Web-based multimedia delivery method of increasing students’ interest in artificial intelligence. The course material features an integrated simulation environment that allows students develop and test AI algorithms in a dynamic and uncertain visual environment. Evaluated the effect of the simulation on the interest level and confidence in class material of students over 3 years.

Lopez Antonio (2001) discusses knowledge engineering, computer software, and possible applications in the field of education. Highlights include
the distinctions between data, information, and knowledge; knowledge engineering as a subfield of artificial intelligence; knowledge acquisition; data mining; ontology development for subject terms; cognitive apprentices; and intelligent agent construction.

**Mardis Marcia** (2001) maintains that search engines do not see and directories can overlook clearinghouses, digital libraries, full-text databases, and learning objects; the hidden Web is rich with these high quality and cutting-edge learning materials. By integrating resources from the hidden Web into the classroom, educators extend their instruction in new and valuable directions.

**Maushak Nancy** (2001) who reviews research in distance education indicates that results are consistent in that there is no significant difference in achievement attributable to the delivery system. This paper attempts to look beyond these studies by examining research related to: learner interaction and control, two different approaches to multiple learning styles, and utilizing intelligent agents to facilitate interaction and collaboration.

**McClelland Bob** (2001) focuses on an undergraduate module which served to provide a rationale for a web based teaching, learning, and a support environment for academic staff and students. Explores module/program support development possibilities on the web from academic, quality, and commercial perspectives as well as the cybernetic and evolutionary nature of learning.

**McFarlane** (2001) outlines the work of Curriculum Services Canada (CSC), a pan-Canadian standards agency that evaluates learning resources. Discusses the CSC process of evaluating conventional classroom resources, the extension of the evaluation process to new electronic learning resources,
evaluation criteria used, and dissemination of results and training to teachers through the CSC Web site.

**Milam John** (2001) describes the emerging study of Knowledge Management (KM), a field that has much to offer administrators in higher education. KM principles recognize that it is important for organizations to "know what they know." It is the organized complexity of collaborative work to share and use information across all aspects of an institution that marks the effective use of knowledge that KM tries to promote. KM will enable colleges to increase student retention and graduation rates, retain a technology workforce, expand Web-based offerings, analyze the cost effective use of technology, and do other things necessary to compete in an environment where institutions cross state and national borders to meet students' needs.

**Neo Ken** (2001) uses multimedia to create a constructivist learning experience and to innovate a multimedia constructivist learning model based on a course at Multimedia University (Malaysia). Assessed students' problem solving skills and ability to evaluate a Web site's design, creativity, and navigational structure by requiring them to reconstruct and improve an existing Web site.

**Pang Peggy** (2001) notes the differences between traditional computer-based training and electronic learning environments using the principles of activity theory. Concludes that an e-learning environment developed on the principles of activity theory characterizes the workplace because it provides a contextual-community perspective that is lacking in traditional CBT design.

**Peter et. al.** (2001) observe that electronic learning has advantages (vast information repository, accessibility), but its merits have been oversold and much does not focus appropriately on user needs and learning styles.
Finding relevant subject matter is challenging and bandwidth limits full use of multimedia.

**Richard et. al.** (2001) maintain that electronic learning should involve a systemic approach encompassing all elements of the electronic learning environment. Successful transition to this model requires development of new mindsets--from teacher directed/facilitated to learner/team centered and from "just in case" to "just in time."

**Ruberg Laurie** (2001) conducted a study on twenty one schools from the United States and Singapore that participated in the evaluation of a high-school biology multimedia CD-ROM called BioBLAST(R). Results include a summary of teacher descriptions of their curriculum-based justifications for using this software as well as a compilation of program features that teachers describe as facilitating successful implementation of new learning technologies.

**Sanders et.al.** (2001) examine student attitudes toward the introduction of a Web component into a general biology course for undergraduate nonmajors that allowed asynchronous learning outside the classroom and increased student-to-student interaction. Results showed a positive effect on student learning, problem-solving skills, and critical thinking skills. Attitudes of females were more positive than males.

**Schaverien Lynette** (2001) describes a research-based, Web-delivered context, the Generative Virtual Classroom (GVC), in which student teachers can develop their ability to recognize, describe, analyze, and theorize learning, and it reports findings of three investigations into its use.

**Shirley et. al.** (2001) propose a framework for the design and development of higher education electronic learning system that focuses less
on technology delivery than on university context, teacher views of learning, course planning, and teaching strategies.

**Stephanie et. al. (2001)** describe an adaptive e-framework for teacher training; assessing the integration of technology into the curriculum; promoting instructional planning; learning and using World Wide Web page construction; designing Web-based inquiry simulations; principles for designing online instruction; effective presentation design; letting teachers interact with the idea of "interactivity"; qualitative data analysis to ascertain the benefits of a Web-based teacher oriented project; implementation of an electronic tutorship support; activities for integrating the Internet in teacher education classes; online delivery of multimedia courseware and successful implementation in educational and curriculum integration.

**Suzanne et. al. (2001)** explain the results of a survey of undergraduate students enrolled in courses that incorporate Web based modules that assessed their satisfaction with learning in a digital instructional environment, with the goal of identifying learners' temperaments as possible predictors of satisfaction. It also discusses the use of Keirsey Temperament Sorter II.

**Tsai et.al. (2001)** implement a networked peer assessment system based on the use of a Vee heuristic. Students submit their homework via the underlying network, then assess each other's homework by offering suggestions through the network. Preliminary results revealed that the networked peer assessment model and Vee heuristic facilitated pre-service science teachers to continuously progress when designing science activities.

**Uehlein Curt (2001)** argues that electronic learning and traditional learning not only can coexist, but can merge to create something far better. A blended solution has the following characteristics: integrated instructional
design, consistent framework and nomenclature, each method delivering its best, flexibility and variety.

**Ueno Haruki** (2001) presents a World Wide Web-based distance learning system to support professional training for librarians. The system is taking the place of a current training course that the National Institute of Informatics (Japan) offers to university libraries nationwide. The course offered is about a system to support interlibrary loan service and is made up of multimedia information such as narration and animation. The course features: repetitive and clear presentation of the current location of the learner within the course; a simulator to learn operation of the system; and learning modes that support stepwise learning. The initial evaluation showed good acceptance of the distance learning system on the whole.

**Visser Gabrielle** (2001) describes the TeleTOP System - a course management system for all faculties, and the implementation process. In order to find out how teachers use their course environments in education, an analysis was made of 60 course environments. Results showed that these course environments were mainly used for the dissemination of information and less for interactive communication.

**Wharrad et.al** (2001) studied the effectiveness of interactive computer-assisted learning of nursing students in cell biology. The students preferred CAL and felt confident in their grasp of the material, even without the presence of lecturers to answer questions.

**Wodarz Nan** (2001) reviews three reports, available from the George Lucas Educational Foundation, on the use of technology in schools: "E-Learning: Putting A World-Class Education at the Fingertips of Children"; "The

Alcaraz Alejandro (2002) provides a survey of computer assisted instruction as applied to the Old English language from the work of the late 1980's pioneers to December 2001. Each instructional item—whether a website, java exercise, or an online course is reviewed and URLs are provided in footnotes. Reviews are accompanied by pertinent background and practical advice.

Ariwa Ezendu (2002) presents the study from the University of North London. Discusses the use of information and communication technology to provide online student support; virtual integration of the curriculum; individual learning styles; and Web sites.

Bangs Paul (2002) discusses two easy-to-use authoring systems—"Potatoes" and "MALTED"--for designing Web-based language instruction. Provides a check list of advice for would-be authors of language learning programs.

Bertelsen (2002) describes the uses of multimedia and scaffolding to support 10- and 11-year-old students' experiences with expository text. Explains that multimedia offers teachers and teacher educators the means to improve student achievement in both authentic literacy skills and social studies topics. Concludes that by designing instructional environments that incorporate specific experiences with text structures and work with a variety of vocabulary activities, teachers can improve students' literacy achievement.

Betty et.al. (2002) conceptualizes the pedagogical shift, driven by Web-based technology, from students being contributors to, in addition to
consumers of, learning materials in terms of a move from an acquisition orientation to a contribution orientation. Describes a Web-supported course as an example of this contribution-oriented pedagogy as well as of other pedagogical dimensions.

**Bringslid Odd** (2002) explains the use of the Web as an advanced calculator using numeric, graphic, and symbolic mathematics interactively with the development of XML-standard MathML. Suggests that the problem of decreasing achievement in mathematics courses can be solved using interactive and personalized documents on the Web and improve the understanding of mathematics.

**Calvert Philip** (2002) points out the trends in Australian higher education and focuses on academic libraries. Highlights include online courses; integrating library services into curriculum development; workload priority for librarians; information literacy; and a case study of the University of Queensland, including their Web site, flexible delivery, special services for remote students, and digital learning objects.

**Chio Chia-Lin** (2002) describes the design of an intelligent Web-based interactive language learning system to support learning English as a second language on the Internet. Highlights include an interactive English writing environment; an authentic conversation learning environment; authoring tools to facilitate teachers' content preparation; system architecture; and multimedia learning environments.

**Chiou-Chang** (2002) proposed a hierarchical hyper concept map (HHCM) course system which consists of a navigation map, concept maps, and hypermedia documents. Results of testing the HHCM as a course representation showed achievement was greater for students learning from the
course represented by HHCM compared with those learning from a linearly represented course. Findings suggest the HHCM has good potential as a device for designing Web-based courses.

**Chun-Yen** (2002) describes a study that explored the effects of teacher-centered versus student-centered multimedia computer assisted instruction on the science achievements of tenth grade students in Taiwan. Results of analysis of covariance on pretest-posttest scores showed the teacher-centered approach was more effective in promoting students’ science achievements.

**Corry Michael** (2002) discusses e-learning communities and their impact on human learning; reviews frameworks used for examining e-learning communities; and proposes a refined framework for future research and development that includes instruction (interactivity, community learning, and collaboration), social interaction (social context and sociocultural and sociocognitive environments), and technology.

**Davies Graham** (2002) considers why technology has not lived up to it expectations in bringing about improvements in language learning. Looks at a Website that offers a considerable volume of ICT training materials for language teachers. Examines the aims behind the site as a whole and the pattern of visits to different modules of the site.

**Edmonds** (2002) review what instructional designers do, describes knowledge management, and indicates how knowledge management is influencing instructional design. The first section defines instructional design (ID) and briefly describes the ID process. The second section covers knowledge management (KM). The third section discusses KM in ID, including projects at the European Commission and Syracuse University that use a KMS in ID, the influence of KM technology on school-based learning and
collaboration among instructional designers, and issues being addressed by ID researchers. It is concluded that KM tools and systems are beginning to be used for the design and development of instructional systems and learning environments.

**German et. al. (2002)** provides an overview of Learning Management System (LMS) software, which is necessary for the creation of a Virtual Centre for Foreign Language Learning. Also describes a new discipline called Web Assisted Language Learning (WALL), which can be broken down into three areas: the Web as a source of resources; the Web as a window of multimedia applications; and the Web as an e-learning platform.

**Gonzalez Byers (2002)** applied the technique of artificial neural networks to predict which students were likely to apply to one Research University. Compared the results to the traditional analysis tool, logistic regression modeling. Found that the addition of artificial intelligence models was a useful new tool for predicting student application behavior.

**Granger Stewart (2002)** discusses the digital preservation infrastructure; accomplishments and changes in the Dublin Core Metadata Initiative in 2001 and plans for 2002; video gaming and how it relates to digital libraries and learning technologies; overview of a music retrieval system; and the online version of the "Mississippi Libraries" publication.

**Gregory et. al. (2002)** described a study that evaluated the impact and use of laptop computers when they were required for graduate information and library science (ILS) students at the University of North Carolina, Chapel Hill. The study revealed the greater use of laptop computers.
Guile David (2002) describes how electronic resources can support learning in small and medium-sized enterprises by identifying connections among management strategy, technology deployment, and knowledge creation. Examples of emerging practices in the use of electronic resources are used to develop a matrix that matches the type of learning (adaptive, collaborative, reflective) with the type of resources.

Hannah et. al. (2002) reviewed the findings from two years of evaluation of Intel(R) Teach to the Future, a professional development program focused on improving classroom technology integration. Intel(R) Teach to the Future is a 3-year, international effort supported by the Intel(R) Corporation. The Center for Children and Technology, part of Education Development Center, Inc., is conducting an external evaluation of Intel(R) Teach to the Future. A sustained impact of the program on teachers' instructional practices was identified.

Hirumi Atsusi (2002) proposes a three level framework for classifying e-learning interactions in distance education. Illustrates how the framework may be used to design and sequence electronic learning interactions, analyze planned interactions to reduce the need for costly revisions, and organize research to help interpret findings and guide future studies.

Huang Hsi-chi (2002) focuses on teachers as designers using constructive hypertext and their perspectives on evaluating Web-based hypertext projects. The research setting was a graduate level course focused on learning hypertext and designing hypertext projects in Web-based environments. This study describes and interprets the participants' learning process in applying hypertext theory in their Web design and evaluating Web-based hypertext. This research captures some of the inspiring moments of
how the participants learned hypertext theory, created hypertext projects and evaluated hypertext projects.

Jeffrey Clem (2002) discusses the need for organizations to satisfy customers' learning needs in a timely manner by properly designing electronic learning systems, which will also provide a competitive edge for the business. Suggests that electronic learning systems should provide access to the optimal balance of instruction, information, and knowledge.

Jodi et. al (2002) describe a software tutorial that can be used by people who are blind to learn the Nemeth Code of Braille mathematics notation. The program was designed for use with the Braille Lite, a note taker that has speech and a refreshable Braille display.

Johnstone Sally (2002) discusses trends in e-learning; its use has crossed a threshold level which has brought it to the serious attention of policy makers; institutional planners are beginning to use the Web to restructure campus services, and there is growing interest in finding a way to share online academic materials.

Kekkonen Moneta (2002) evaluates the effectiveness of Web-based, interactive, multimedia electronic learning materials by comparing students' learning outcomes in the lecture and online versions of an introductory computing course at Hong Kong University of Science and Technology. Suggests that the use of carefully designed interactive electronic learning modules fosters higher order learning outcomes.

Kevin et. al. (2002) discuss the increasing popularity of synchronous e-learning. Attribute its popularity to the familiarity of the format: it resembles
traditional classroom training with real-time interaction. Suggest when to use synchronous and when to use asynchronous e-learning.

**Kilby Tim** (2002) maintains that Web-based training has had achievements and disappointments as online learning has matured. Best practices include user-centered design, knowledge object structures, usability engineering, and formal evaluation. Knowledge management, peer-to-peer learning, and personal learning appliances would continue to alter the online learning landscape.

**Laboone Emet** (2002) discusses the importance of cultural considerations in instructional design and focuses on audio messages in multimedia materials. Describes the development of a Web-based audio instructional series by a consortium of Historically Black Colleges and Universities, including planning, context selection, implementation, cost effectiveness, formative evaluation, and research methodology.

**Lin Chi-Hui** (2002) described a study that determined the implications of computer graphics types and epistemological beliefs with regard to the design of computer-based mathematical concept learning with elementary school students in Taiwan. The study revealed positive results in student performance, and students' attitudes toward mathematics learning.

**Lin et.al.** (2002) describe a study that implemented an Internet-based project in a Taiwanese secondary school biology class and investigated its effect on the cognitive preferences held by students and on their performance. The study reveales the effectiveness of internet-based instruction on the cognitive preferences of learners and their performance.
Lu Ching-Fang (2002) proposes a novel methodology that employs Bayesian network software to assist teachers in efficiently deriving and utilizing the student model of activity performance from Web portfolios online. This system contains Web portfolios that record in detail students’ learning activities, peer interaction, and knowledge progress.

Michael (2002) investigated the extent to which problem-solving abilities, specifically the integrated science process sub skills of data interpretation and hypothesis formulation to be enhanced through the implementation of an instructional strategy comparing two- and three-dimensional computer-based graphic techniques. The research study also examined the acquisition of domain-specific science knowledge. The results of the three-factor analysis of variance indicated that (1) no significant differences existed on measures of the integrated science process sub skills of data interpretation; (2) no significant differences existed on measures of the integrated science process sub skill hypothesis formulation; (3) a significant difference existed on a measure of domain-specific science knowledge with the transitional operational thinkers outperforming the concrete operational thinkers; (4) the effects of two- and three dimensional computer-based group methods were consistent across levels of cognitive ability and specific orientation ability.

Mitchell et. al. (2002) reported descriptive analyses of production data gathered from experienced instructional developers who used a commercial authoring package and supplemental coding over a year period to produce three separate instructional lessons on thinking skills as part of a larger commercial educational product.
Oakes et.al.(2002) define information and management and the importance of realizing the difference between the two terms. Looks at knowledge management and how it interfaces with electronic learning.

Olive John (2002) explains TIMA (Tools for Interactive Mathematical Activity), that were designed to provide elementary school children with contexts in which they could enact mathematical operations. Discusses differences from drill and practice software; provides examples of how the TIMA were used by children to engage in cognitive play; and emphasizes the teacher's role.

Pamela et. al. (2002) describe a study that investigated the types of interaction that graduate students perceived to be important for e-learning. The study discusses content interaction, conversation and collaboration, interpersonal and meta cognitive skills, and need for support; it explains the Online Learning Interaction Inventory; and reports that flexibility and convenience were primary reasons for distance learning.

Payiatakis Damian (2002) discusses electronic learning from the viewpoint of human resource professionals. Defines the promise of electronic learning, determines if it is real, and presents the factors that need to be in place to implement an effective electronic learning package for both organizations and their employees.

Peat et.al. (2002) discuss undergraduate students' demand for a greater flexibility in the way that they receive their instruction, and introduce instructional changes from a teacher-centered focus to a student-centered focus at the University of Sydney. The study uses a virtual learning environment (VLE) to encourage independence and increased flexibility of access.
Pratt David (2002) explored the various types of purposes the teachers have for using the Internet with their students. It was concluded that internet was used to a greater extent for the preparation of lessons.

Raymond et. al. (2002) explained a study of Australian secondary school students that identified the conditions and individual characteristics that would best support learners' acceptance of control within hypermedia, based on evidence from the learner control literature. Investigated effects of prior domain knowledge, learning activity structure, ability, and attitudes on acceptance of control opportunity and knowledge acquisition.

Ritland et. al. (2002) review research related to computer-mediated communication, electronic learning and interactivity, including instructional strategies and activities suggested by the research. Categorizes definitions of interactivity, identifies gaps in the research, and presents common research conclusions across studies to provide linkages from research to practice.

Robert Bollet (2002) discusses the concepts of learning and training and focuses on how to incorporate the whole brain in the learning process when personalizing electronic learning. Suggests that trainers will need to learn teaching strategies that embrace the right brain's need for time and space to examine, contemplate, integrate, and utilize information.

Roberts Anthony (2002) discusses reusable digital learning resources or objects in distance education and training. Focuses on the pivotal role of Metadata and issues relating to classification, description, and meaning, specifically issues of semantics; and describes the CanCore Learning Object Metadata Application Profile.
Romi Shlomo (2002) describes a study in Israel that was conducted to examine the attitudes of dropout adolescents to electronic learning and to compare these to the attitudes of normative 10th graders. Considers demographic differences, including parents' education and computer ownership; motivation; enjoyment; cognition; and accessibility of computers.

Sampson Demetrios (2002) discusses the knowledge-on-demand (KOD) paradigm as it emerges from the needs of a knowledge-based society. Presents basic requirements for on-demand learning; discusses front-end users, such as learners, and back-end users, such as publishers and service providers; defines typical user tasks; and outlines work towards a technical solution to support the KOD concept.

Scheuermann Friedrich (2002) outlines key issues, principles, and planning and development issues for instructional design in virtual learning environments. Addresses new teaching strategies and support for teacher competence with information and communications technology.

Simon et. al. (2002) point out that e-learning has potential benefits but it requires a "smart" environment: support staff and resources, diagnostic systems to measure electronic functionality, and a system wide approach that goes beyond mere delivery of content.

Strother Judith (2002) observes that E-learning can have economic advantages for corporate training, and evaluations show learner satisfaction. However, research shows mixed results for learning outcomes and translation of training to work performance, and more systematic studies are needed to demonstrate return on investment.
Sudhakar (2002) presents the characteristics and development of self-learning material (SLM) in distance education. Discusses teaching with programmed learning; structure of SLM; and how SLM helps in self-study. Discusses the advantages of print materials as accompanying programmed instruction, because they are portable, well structured, compact, and easily accessed by the student.

Susan et. al. (2002) discuss the limited exposure many preservice teacher programs have regarding innovative uses for technology in the classroom. The study describes the use of a WebCT-based virtual field trip to an elementary school, using constructivist theory as a framework to help preservice teachers rethink traditional instruction.

Takashi (2002) reviews trends in the use of ICT in Japanese higher education institutions. Highlights include recent trends in national policy; educational policy; use of communication satellites; broadcasting; Internet use; videoconferencing; issues concerning virtual universities; and use of multimedia.

Tavalin (2002) discusses enhancing student achievement through project-based learning with multimedia, and describes project-based multimedia learning, and also analyses the systemic support.

Thomas et. al. (2002) suggest that distributed learning environments and content often lack a common basis for the exchange of learning materials, which can hinder or even delay innovation and delivery of learning technology. Standards for platforms and authoring may provide a way to improve interoperability and cooperative development. Provides an XML-based approach to this problem created by the IMS Global Learning Consortium.
Weinroth et. al. (2002) discuss the increasing amount of educational content on the Internet for both educational and business applications and reviews basic learning theories, instructional design theories, and factors affecting successful Web-based tutorials. Proposes a model synthesizing instructional design pedagogy and Web design concepts.

Wheeler Steve (2002) discusses new learning technologies, including student preferences in distance education; developments in the United Kingdom and other countries; combining Web-based learning with traditional face-to-face classes and videoconferencing; and corporate perspectives on Just in Time (JIT) training and lifelong learning.

Wible David (2002) describes the design of an intelligent Web-based interactive language learning system to support learning English as a second language on the Internet. Highlights include an interactive English writing environment; an authentic conversation learning environment; authoring tools to facilitate teachers' content preparation; system architecture; and multimedia learning environments.

Wisher Robert (2002) reviews the historical findings of computer-based instruction research and 47 evaluations of web-based courses in higher education published 1996-2002. Tabulates results in terms of content area, educational level, sample size, use of comparison group, and course characteristics. Assesses experimental designs, effect sizes, and use of features unique to web-based instruction.

Zahner Jane (2002) examines the relationship between online professional development, knowledge management, and electronic learning based on an online discussion in a graduate course in instructional technology.
Discusses changing definitions of professional development and how it is now being evaluated through measures of school and student improvement.

Allen et. al. (2003) investigated the extension educators (n=17) who completed two of five technical sections from an aquaculture CD-ROM tutorial. Evidence from pre/post-training questionnaires, content assessments, and follow-up interviews revealed favorable attitudes toward computer-based inservice training. The ability to spend less time out of their county and to review materials after training were two of the key benefits.

Asakawa (2003) draws on published evaluations of Internet-mediated (I-M) educational, business, and policy games to establish an inventory of lessons for future I-M games. These types of I-M games have important concerns in common: objectives, role-play, synchronicity, game facilitation, and participant interaction. Lessons of design and implementation derived from these experiences are identified and explored.

Bax Stephen (2003) provides a critical examination and reassessment of the history of computer assisted language learning (CALL), and argues for three new strategies--restricted, open, and integrated. Offers definitions and descriptions of the three approaches and argues that they allow a more detailed analysis of institutions and classrooms than earlier analyses.

Boettcher Judith (2003) discusses characteristics of well structured content as it relates to the design of instructional technology resources. Topics include online course design; online learning; principles of designing for learning; multimedia learning resources; knowledge structures; digital learning resources; and differences in digital content.
Brown et. al. (2003) presents seven strategies to assist educators in providing students with a high quality online communication experience: begin with curriculum; spend time planning; encourage a positive social climate; understand the unique nature of online communication; encourage good reading and writing skills; deal with inappropriate behavior and attitudes; use effective facilitation skills to the larger goal of enhancing student learning.

Burston Jack (2003) focuses on the assessment of the effects of instructional technology (IT) on the foreign language curriculum. Offers a general overview of the evaluation of IT and seeks to provide a clearer understanding of the evaluation parameters that need to be taken into consideration when establishing the infrastructure for the on-going assessment of IT.

Cameron Brian (2003) reports on a study that compares the performance of students enrolled in two sections of a Web-based computer networking course: one utilizing a simulation package and the second utilizing a static, graphical software package. Analysis shows statistically significant improvements in performance in the simulation group compared to the non-simulation group.

Chen Der Thanq (2003) reviews technology integration efforts in Singapore. Discusses examples of online learning in schools under four broad categories: cyber conferencing, e-learning service providers, e-publication, and wireless technology. Describes ways information technology is being used at the National Institute of Education in Singapore, as a tool for communication, visualization, data management, construction, and cognition.

Claus et. al. (2003) discuss the design and maintenance of computer-based teaching and learning environments and illustrate consequences of
evolution and change in Web-based courses. Focuses on changes in content; format of the course; infrastructure, including hardware, systems, and software; and pedagogy, or instructional design, including knowledge modeling, active learning, collaborative learning, and autonomous learning.

**Curda** (2003) examines past military distance education practices and then focuses on discussion of the Department of Defense's (DoD's) initiative in Advanced Distributed Learning (ADL). Outlines some of the potential problems that should be addressed in the near future and possible solutions towards the goal of implementing a successful ADL system for military educational organizations.

**Donna et. al.** (2003) analyzed a Web-based curriculum requiring critical thinking and creative problem-solving skills. A multidisciplinary team of educators created the "virtual exchange." Students are assigned a scenario character to portray in their interactions with the other characters (students). They interact on the Internet to promote critical thinking skills in a "virtual exchange" of research-based ideas. The process used to design this exchange is discussed.

**Gibson Keith** (2003) attempts a rhetorical analysis of the history of artificial intelligence research. Responds to scholarly needs in three areas: the rhetorical nature of science, the social construction of science knowledge, and the rhetorical strategies used in artificial intelligence. Suggests that this work can help rhetoricians more accurately describe the construction of scientific knowledge and better prepare their students to take part in that construction.

**Gold Martha** (2003) explains that recent technology extend its product training to customers and business partners. This practice allows both
employees and customers to access e-learning selections for their training and information needs.

**Gregor et. al.** (2003) construct "SeeWord" which is a highly configurable word processing environment, which assists dyslexic users in producing and reading text. Three prototypes of the software were developed and evaluated. The third was used in an experimental study with six dyslexic school pupils. Research showed five out of the six, aged 14-16, years benefited from the use of specialized software when reading text from a computer screen.

**Heaney Liam** (2003) explores some of the key issues associated with the use of information and communications technology (ICT) in the classroom. To illustrate ICT integration, a teaching project on dinosaurs, which has been developed with students ages 10-11, is presented. A detailed scheme of work and lesson plans is included.

**Herrmann et. al.** (2003) introduces different kinds of meta knowledge which all have positive influence on the usage of knowledge management systems. Presents results from a qualitative study conducted in five German companies, and derive relations between kinds of meta knowledge and the characteristics of knowledge management systems. Only if this experience with meta knowledge guides the design of knowledge management systems can a technological innovation be successful.

**Hewitt Jim** (2003) made an attempt in developing distance education courses according to needs/interests of conference participants, course requirements, and nature of the instructor's online facilitation. Findings of this research suggest other factors. Analysis of threads and their growth patterns reveals a bias in favor of elongated note structures, explained by a tendency
for computer conference users to focus on recently introduced notes and a reduced tendency to revisit older, more established notes.

The study of Hoag Anne et. al. (2003) focus on research judged to have implications within journalism and mass communication education, discusses literature, which considers computer use in course design and teaching, student attributes in a digital learning context, the role of digital information in student learning outcomes, and the role of faculty attitudes.

Hsiu-Mei et. al. (2003) discuss how the Web is used and applied in online learning in Taiwan. Presents five different aspects of how Web-based online learning is facilitated--courseware-, theory-, instruction-, community- and assessment-oriented--with detailed descriptions of projects implemented over the last several years. Emphasizes a call for a localized approach that integrates the traditional concept of education.

Insung et. al. (2003) analyze three applications of online learning and technology in South Korea: development of single-mode virtual universities; online education in conventional universities; and Web-based corporate training. Concludes with principles of online learning derived from experiences in implementing such environments.

Jennifer et. al. (2003) present general guidelines that can further assist the molding of successful, high-quality, Web-based training for adult learners include: learner-centered curriculum; pedagogically appropriate activities; clearly defined objectives, goals, and expectations; easily accessible content; content in multiple formats; sense of community; shorter, focused training; expert online facilitation; and immediate online and off-line technical support.
Kinoshita et al. (2003) look at the use of Web-based resources in intermediate Japanese classes and argue that resource-based learning expands students' learning environments. Suggest that in order to be successful in resource-based learning, students need to develop strategies to deal with authentic Web resources and to use information searching skills and critical thinking skills effectively.

Kinshuk Yang (2003) examines current limitations of Web-based learning systems (WBLS) in higher education and describes a prototype Web-based Asynchronous Synchronous Environment (WASE) that is designed to circumvent those limitations.

Laine Leslie (2003) presents findings from a worldwide information technology firm. The research shows that electronic learning must deliver practical skills for it to be effective. Asynchronous e-learning was not effective when used as a standalone method. Most participants preferred classroom-based training over e-learning because of the personal interaction.

Lally Vic (2003) explores the complexity of researching networked learning in higher education. Suggests that no single theoretical model currently available is sufficiently powerful to provide a framework for a research agenda that takes into account key aspects of human agency. Presents findings of a multi-method analysis of the learning and tutoring processes occurring in an online community of professionals engaged in a Master's Program in E-Learning.

Langone John et.al. (2003) discuss features of multimedia instructional tools that may provide students with moderate to severe mental disabilities with more effective and efficient simulated instructional tools in the area of transition skills (i.e., community literacy skills, mobility skills, and safety skills).
Information about a project to develop a multimedia environment for this type of instruction is also provided.

**Leemkuil** (2003) describes the development of a collaborative Internet-based simulation game for learning to solve knowledge management problems. The game builds on two starting points: on psychological and pedagogical developments in learning and instruction, and on a perceived need for better training of people working in the emerging field of knowledge management. The study proves effectiveness of simulation game in solving management problems.

**Lewalter** (2003) studied the effects of including static or dynamic visuals in an expository text on a learning outcome and the use of learning strategies when working with these visuals. Results for 60 undergraduates for both types of illustration indicate different frequencies in the use of learning strategies relevant for the learning outcome.

**Lowe** (2003) studied the selective processing of information in dynamic graphics by 12 undergraduates who received training aided by animation and 12 who did not. Results indicate selective processing of the animation that involved perceptually driven dynamic effects and raise questions about the assumed superiority of animations over static graphics.

**Magnus et. al.** (2003) report a part of a wider study aimed to develop a theoretical understanding of learning in networked courses, where the subject matter is directly related to participants' practical experience. The study proposes taxonomy as a tool for analyzing the learning potential. A phenomenographic perspective on learning underpins the study.
Marjorie et. al. (2003) propose a means by which inflectional paradigms can be promoted from their present status as references at the end of textbooks to a more central role in the language learning process. The study suggests that a computer setting can enhance this process.

Martha Gold (2003) describes the five-part series of case studies on enterprise wide electronic learning. It also describes how Kodak’s approach to a global learning management system which integrates 80 discrete human resource systems into one.

Mayer (2003) studied the learners at a computer workstation who received a narrated animation about lightning formation. Then, they took a retention test, a transfer test, and rated the speaker. The results are consistent with social agency theory, which posits that social cues in multimedia messages can encourage learners to interpret human-computer interactions as more similar to human-to-human conversation.

Nancy (2003) describes the development of Web-based literature guides for preservice teachers to use in preparation and student teaching and for secondary-level English/language arts teachers to use in their classrooms. Discusses assembling materials for the web guide; an overview of site features; structure for the Web guide; design for Web guide activities; and challenges.

Philippa et. al. (2003) present a methodological framework for practice-based research in the field of networked learning, based on a case study evaluation of a networked professional development initiative for information services staff in higher education. The theoretical case for the framework is made with reference to principles associated with constructivist program evaluation and interpretivist and critical traditions in action research.
Pindiprolu Sekhar (2003) examined three Web-mediated experiential case strategies with 79 pre service teachers to facilitate practice of functional behavioral assessment skills. Results from the information group, chat group, and student interactions group suggest that the three teaching tactics were equally effective in facilitating the application of functional behavioral assessment skills.

Pino Jose (2003) presents information about Knowledge Construction Awareness (KCA) and the design of a software tool that allows users to capture information about group work and evaluate how this kind of awareness affects the collaborative work process in computer-mediated interactions. Discusses exploratory study of 10 groups which used software.

Qiyun Wang (2003) presents an overview of various efforts toward developing online education in China, and describes the progress that has been made both in the areas of higher education and basic education in recent years. Introduces some ongoing national projects related to online education. Discusses issues pertinent to online education and provides recommendations.

Ramsay Guy (2003) investigated learner perceptions of the use of asynchronous computer-mediated communication (CMC) as a means of extending the community of learning in tertiary Chinese language and non-language courses. There existed pedagogical benefits in employing CMC, but the benefits did not necessarily arise from community building.

Reed Philip (2003) reviews developments in telemedicine and a number of related areas (telecommunications, virtual presence, informatics,
artificial intelligence, robotics, materials science, and perceptual psychology). Provides learning activities for technology education.

Roberts Gillian (2003) shows that most current university teachers' conceptions of and approaches to using the Web for learning and teaching are far removed from the concept of networked learning. If approaches to using the Web are to move closer to definitions of networked learning, teachers' conceptions need to develop from instructivist, information transmission mode to constructivist, learning facilitation mode.

Rosenberg Marc (2003) proposes the need for electronic learning to be redefined to move beyond training toward a wider array of solutions, from performance support to knowledge management. Topics include balancing employees' instructional needs with informational needs; integrating online courseware with knowledge systems; communities of practice; access to experts; and information repositories.

Sayuki et. al. (2003) describe computer-assisted group project activities, including the creation of a Web site and a poster, employed in beginners' Japanese language course. Claims that the activities were positively received by students and suggests that three factors such as self-directed learning, group dynamics, and computer-related skills should be taken into account for the successful implementation of the activities.

Shannon et. al. (2003) examine the benefits, challenges, and methods of expanding access to adult literacy with online distance education (ODE). Reasons for considering ODE challenges of using the World Wide Web in adult and research issues in implementing ODE for adult learners were also studied. The study outlines many benefits of online courses.
Simon et al. (2003) report results that indicated that average persisters interacted more than either high or low persisters and discusses implications for forming effective cooperative learning groups. “Vorleser,” students produced in collaborative groups a Web site with information on Schlink, the text’s cultural-historical background, and its reception, and they developed an interactive, annotated “Vorleser”-program on the Web. Suggests that the project encourages content-based and student-centered teaching.

Sunal Cynthia (2003) investigated an interdisciplinary course focusing on modeling scientific systems. Investigates elementary education majors' applications of three artificial intelligence concepts used in modeling scientific systems before and after the course. Reveals a great increase in understanding of concepts presented.

Svenja et al. (2003) assess positive affective states experienced by users of a one-hour program in a hypermedia learning environment. Results showed that the users of the training program were put into a positive mood and about a quarter of the users experienced "flow." Results are discussed in the context of self-directed learning.

Taylor Peter (2003) discusses pertinent issues relating to implementing online learning models in a higher education context. These issues include the changing roles of staff and students as they adopt new learning approaches; the notions of flexible learning and delivery; and the quality of education provided.

Timothy (2003) aims at establishing a foundation for the study of the pedagogical value of using the development of hypertext documents as a student assignment. The editor compiled an eclectic collection of 10 chapters
from eight different contributors. Chapters fall within three general categories: theoretical foundations, enabling technologies, and reports of experiments.

**Van Leer** (2003) describes how one middle school approached the challenge of integrating technology skills into the curriculum by engaging a team of administrators, teachers, and library media specialists to systematically create a framework and curriculum aligned with national and state standards. Discusses creating the framework; curriculum design and core objectives; and implementing the curriculum.

**Voon Chet** (2003) outlines the enhancement of a learning technique by the deployment of a novel multimedia learning system. Presents a detailed overview of the MMLS starting from the content development flow to the implementation stage. This project is being launched at the Multimedia University Malaysia. Macromedia Dreamweaver and Macromedia Flash were used to develop the interactive environment within two campuses.

**Yagodzinski Elizabeth** (2003) describes the issues in creation or support of an e-learning program. It covers technical and pedagogical aspects associated with the development and maintenance of web-based training (WBT). It also provides the templates, design documents, worksheets, and direct web links to additional information and applications available to designers of WBT.

**Ziguras Christopher** (2003) reports on research that investigated the use of touch screens by children in early childhood and junior primary settings by introducing touch screens in five classrooms in Melbourne, Australia. The study revealed the positive findings.
3.2 SUMMARY OF LITERATURE SURVEY

The review of prior studies reveals that computer assisted instruction, Artificial Intelligence and Expert Systems, Digital Learning Technology, E-learning, Multimedia Technology and computer animation technology contribute significantly for better instructional process.

Many studies employ Computer Assisted Instruction in different disciplines such as mathematics, social studies, physics, chemistry, biology, psychology, engineering graphics, English language etc., at secondary level, post secondary level, elementary level, college level etc. It is also observed from the review of literature that multimedia based computer assisted instructional courseware developed are very scanty in number in the discipline of biological science at graduate level. This inference has motivated the researcher to develop a Multimedia Web Based Digital Learning Technology Courseware for teaching biological concepts at graduate level.

Some studies that were reviewed reflect the impact and application of multimedia technology in different subject areas such as Geology, Economics, Engineering Education etc., It is known that only a few studies are related to the application of multimedia technology in biology teaching at college level. Likewise, some studies deal with computer animation technology in various disciplines such as trigonometry, college chemistry, statistics etc; It is inferred from the above survey, in India, it is very hard to cite a single research work in any of the disciplines clubbing both multimedia technology with the animation technology for their investigation purpose, at collegiate level. This database provided ample scope for developing a Multimedia Web Based Digital Learning Technology courseware to enhance the curricular potentialities in teaching biological concepts at graduate level.
The review of literature helped the researcher from the methodological point of view too. It was learnt that most of the research studies cited in this chapter for review relied on content analysis and experimental design as the appropriate methods for finding out the lapses and redemption. For the present study also, the validity of the experimental design was deemed significant for evaluating the effectiveness of the Multimedia Web Based Digital Learning Technology courseware.

On the basis of the review of related research studies and from the above discussion, bringing in newer teaching aids such as computer based courseware and improving the teaching of science concepts at graduate level become a significant need. Hence the present study. The review of prior studies has led to the following rationale for the present study:

3.3 RATIONALE FOR THE PRESENT STUDY

headings namely, Computer Assisted Instruction, Multimedia Technology, Artificial Intelligence and Expert Systems, Digital Learning Technology, E-learning and Computer Animation Technology has thrown light on the application of newer computer based technology for the development and use of educational coursewares in teaching subjects including biological science. This inspired the researcher to develop a courseware for Multimedia Web Based Digital Learning Technology.

2. It has been decided to develop Multimedia Web Based Digital Learning Technology courseware for individualized instruction. The bases for the preference for courseware are the learning environments and the technical constraints associated with each specific instructional methodology.

3. The Multimedia Web Based Digital Learning Technology courseware is an integrated set to the learners. Informational inputs could be aptly perceived only when the multimode extracting capacity of the learner is fully utilized. This is accomplished through multimedia based digital courseware, which is designed in such a way to entertain the visual and aural senses. This courseware takes care of giving required attention to perceptual stimulus inputs in the learning process.

4. More number of learners is to be educated simultaneously. It calls for a sales approach for the delivery of contents. The Multimedia Web Based Digital Learning Technology courseware for teaching biological concepts aptly provides the cues for attention, arousal and maintenance of the learning desires.

5. The informational inputs gained through Multimedia Web Based Digital Learning Technology courseware are to be transformed to knowledge level through personalizing the experiences. Through trial and error, the learners can acquire different range of experiences. Since Multimedia Web Based
3.4 CONCLUSION

This Chapter, “Literature Scanning” shows the significance in developing Multimedia Web Based Digital Learning Technology courseware for teaching biological concepts at higher education level. The utilization of computers and the application of multimedia based educational courseware in different disciplines for teaching is becoming wider. Moreover, the propagation of computer based sophistication is also getting newer color of technologies. The use of computers in teaching is yet to receive the required emphasis in India. Multimedia Web Based Digital Learning Technology is becoming prevalent in U.S.A, U.K and in certain developed countries. In India, Multimedia Web Based Digital Learning Technology at higher education level is slowly getting attention. The research studies carried out so far in India are only through multi-media where different teaching aids were used to teach a lesson and not through computer, which provides audio and video effects simultaneously through computer mediated interactions and with the integration of newer technologies like computer animation.

The courseware developed on Multimedia Web Based Digital Learning Technology is installed in local area network server, under a dedicated work station, along with other accessories; the client can commonly share the resources available at the server or at the work stations. The investigator has developed a Multimedia Web Based Digital Learning Technology courseware to teach the lessons so as to avoid repetition and monotony. Moreover, providing sound blasters to all the 25 or 50 students in a classroom at a time would cause chaos. To avoid all these problems and to rule over the situation, the investigator has made attempts to develop a Multimedia Web Based Digital Learning Technology courseware wherein, the learner learns his
lessons at his own pace and the learner is awarded credits as soon as he completes a lesson successfully. This sort of programming may be carried out in the proposed Multimedia Web Based Digital Learning Technology courseware and this may motivate the learner in learning the lessons effectively and the subject matters get reinforced.

The present study is the first of its kind in India. It is hoped that the present study may serve as a base for future research in biological science in multimedia based learning at graduate and postgraduate levels. Once the review of related study is completed, the next step on the part of the investigator is to plan for the logical and sequential execution of the development of the courseware. This is precisely dealt with in the next chapter.