

EXPLORING RESEARCH ON INTERNET-BASED LEARNING: FROM INFRASTRUCTURE TO INTERACTIONS

Janette R. Hill
University of Georgia

David Wiley
Utah State University

Laurie Miller Nelson
Utah State University

Seungyeon Han
University of Georgia

16.1 INTRODUCTION

Internet-based technologies are expanding and changing at an exponential rate. Few technologies have had such a global impact; further, few technologies have impacted such a wide range of sectors in our society across and within various socioeconomic groups. This is particularly true of the World Wide Web (Web). Business to education, youth to elders, world powers to third world countries—all have felt the impact of the web.

The Internet and Web have not only received the greatest attention, they have also experienced the greatest distribution. According to the U.S. Department of Commerce (2002), Internet access and use in the United States has expanded exponentially. As of September 2001, approximately 54 percent of the population were using the Internet. This increase was seen across

demographic groups and geographic regions, representing one of the most significant shifts in terms of technology infusion.

Education has certainly been impacted by the Web. As stated by Owston (1997), “nothing before has captured the imagination and interests of educators simultaneously around the globe more than the World Wide Web” (p. 27). From the individual classroom to the media center, it is difficult to imagine not having some form of access to the Internet in schools, both K-12 and higher education, to support the learning and work that needs to be done.

Surprisingly, despite the seemingly widespread infusion and use of the Internet, we have yet to develop a clear understanding of the impact these technologies have had and are having on the processes of learning. Theoretical and research foundations have not kept pace with technological growth and use. Several questions have been posed and answered; yet many more

remain. We are developing a good idea of “what” the technology can do, while “how’s” (e.g., *How can the Internet assist us with teaching and learning processes?*) and “why’s” (e.g., *Why this technology now?*) remain relatively unclear. It is important that we examine the how’s and why’s in our research to understand the value (current and potential) the Internet can bring to the learning process. The purpose of this chapter will be to explore the research that has been completed to date, and to identify unresolved issues and problems that might help guide future research.

16.1.1 Organization of the Chapter

The chapter is organized categorically to cover research related to the Internet. Theoretical foundations underlying research related to the Internet-based learning are described in the first section, including instructional approaches and learning styles. The subsequent four sections of the chapter represent major topical areas revealed in our review of the literature:

1. Designing Internet-based learning environments,
2. Teaching and the Internet: uncovering challenges and opportunities,
3. Learning from and with the Internet: learner perspectives, and
4. Learning through the Internet: interactions and connections in online environments.

We close the chapter with emerging issues and considerations for future research.

We recognize there are other areas that could be included in the review; indeed, we found it challenging to make decisions regarding major topical areas to cover for our review. Furthermore, we recognize that the “prime” areas will continue to shift and change over time. Rather than being all-inclusive and definitive review, we feel the topics included in our chapter reflect current trends in Internet-based research, indicating areas where future research may be leveraged.

16.2 THEORETICAL FOUNDATIONS UNDERLYING INTERNET-BASED RESEARCH

Internet-based learning has been occurring since the start of ARPANET (the precursor of the current Internet) in the 1960s. More formal uses of the Internet for learning were established in the 1980s with the formation of moderated newsgroups (Schrum & Berenfeld, 1997). The Internet technology of the Web is also a newcomer to the distance learning movement, with one of the first educational applications documented by ERIC in 1994 with Blumberg’s report on the use of MendelWeb.

Despite the relative newness of these technologies, researchers have sought to establish a theoretical foundation to guide research and practice. In the following section, we discuss theoretical constructs related to learning and the Internet that have been empirically investigated.

16.2.1 Theoretical Constructs for Internet-Based Learning

In 1973, Michael Moore issued a call for examination of and research related to more “macro-factors” in distance learning in general. As reported by Moore & Kearsley (1995), Moore’s list included: defining the field of distance learning, identifying the critical components of teaching and learning at a distance, and building a theoretical framework for distance learning. While not directly related to Internet-based learning, there are connections between the two areas. Almost 30 years later, a common definition is still not agreed upon, the critical components continue to be examined, and a unified theory of distance or Internet-based learning has not been established. There has, however, been significant progress made with research examining each of the macro-factors described by Moore: transactional distance, interaction, control, and social context.

16.2.1.1 Transactional Distance. Michael Moore first introduced his theory of transactional distance at a conference in 1972 (Moore & Kearsley, 1995). In his explanation, Moore emphasized that his theory was a pedagogical theory. As explained by Moore and Kearsley, what is of interest is the effect that distance has on instruction and learning. Moore’s theory focuses on the shifts in understanding and perception that are created by the separation of teachers and learners.

There are two primary variables in the theory: structure and dialogue. The structure is determined during the design of the course, whereas the dialogue is a function of the communication between the instructor and learner during implementation. In Moore’s theory, *distance* is not a geographical concept but rather a concept defined in the relationship between structure and dialogue. According to McIsaac and Gunawardena (1996), “education offers a continuum of transactions from less distant, where there is greater interaction and less structure, to more distant, where there may be less interaction and more structure” (p. 407).

Moore’s theory has received recent attention in the research literature. Jung (2001) analyzed previous research related to teaching and learning processes of Web-based instruction (WBI) in order to develop a theoretical framework of WBI using Moore’s Transactional Distance Theory as a foundation. The purpose of Jung’s research was to provide a better understanding of the essential pedagogical components of WBI. Jung’s proposed model extends Moore’s theory and includes the following elements: infrastructure (content expandability, content adaptability, visual layout), dialogue (academic interaction, collaborative interaction, interpersonal interaction), and learner collaborativity (learner collaboration) and learner autonomy. One conclusion from Jung’s work is that previous work has not been widely explored—thus creating an opportunity for more theory-based research as well as theory development.

16.2.1.2 Interaction. The concept of interaction has received considerable attention in the literature related to distance Internet-based learning. Four types of interaction

have been described in the literature: learner–instructor, learner–learner, learner–content, and learner–interface (Hillman, Willis, & Gunawardena, 1994; Moore, 1989). Each is briefly described below.

Learner–instructor interaction is a key element that provides dialogue between the learner and the instructor. This form of interaction enables feedback as well as opportunities to motivate and support the learner. Learner–learner interaction encompasses the dialogue among and between students in the online course. This dialogue may include the exchange of information or ideas.

Learner–content interaction is critical to the learning process, particularly at a distance. Articles, textbook chapters, and Web sites are all examples of the kinds of materials a learner may need to interact with to extend their understanding in an online course. Finally, learner–interface interaction relates to the learners' ability to use the communication medium facilitating the online course.

In a recent study, the concepts of learner–instructor, learner–learner, and learner–interface interactions were described as having an impact in online courses (Hill, Raven, & Han, 2002). Learners reported that reminder messages [things you Could be doing, Should be doing and Must be doing (CSMs)] sent by the instructor were particularly helpful with time management. Participants also mentioned that motivational statements of support and encouragement from their peers were valuable. Finally, the study indicated that the learners' inability to successfully interact with the mediating technology had the potential of being a significant source of frustration, leading to dissatisfaction with the online course.

16.2.1.3 Control. The issues associated with control have been a part of the theoretical foundations of education for many years. Alessi and Trollip (2001) have conducted considerable research in this area, particularly as it relates to multimedia systems. As one of the most robust multimedia systems currently available, the Internet, and particularly the Web, provides much more user control than in most educational software. Alessi and Trollip's research indicates that control—in the forms of learner and system—are critical in to the development of effective learning environments. Further, they suggest that the proper availability and use of controls is particularly important for learners when working on the Web.

In distance or Internet-based learning, the two concepts that have been linked with control are independence and learner control. Independence relates to the learners impressions of how well they can function on their own. Independence was one factor that Bayton (1992) found relevant in her research. According to Bayton, a balance needs to be obtained between independence, competence and support to have a successful online experience.

The notion of independence is directly tied to internal and external locus of control (see Hayes, 2000, for an extensive overview of the research). When a student has an internal locus of control, she or he perceives that success is a result of personal accomplishments and effort. An external locus of control, in contrast, leads the student to feel that she or he is dependent on factors outside of her/his control for success

(e.g., fate, luck). Each of these has implications for learning in Internet-based learning contexts. Students with internal locus of control have been found to have a higher completion rate than students with external locus of control (Rotter, 1989). Assisting learners with adjusting their perceptions of control, especially from external to internal, can greatly facilitate increases in completion of Internet-based learning experiences.

16.2.1.4 Social Context. The social context in which a learning experience takes place is an important consideration whether the interaction is face-to-face or at a distance. However, recent research has emphasized the import role that social and cultural attributes play in learning from and with the Internet. As pointed out by McIssac and Gunawardena (1996), technology may not be culturally neutral; therefore, it is important to attend to the context in which the interactions will take place so that learning experiences can be planned appropriately.

Other researchers have focused on the concept of presence as it relates to social context. In her work on community building, Hill (2002) discusses the importance of knowing there is a **there**, there—meaning it is important for learners and facilitators to have a sense that others are a part of the interactions and that although the space is virtual, that it does share some of the same properties as a physical space.

Moller (1998) also talks about the role of presence and being there in his work in asynchronous Web-based environments. According to Moller, social presence is the degree to which an individual feels or is seen as *real* by colleagues working in the online context. When a learner has a higher degree of social presence, they are more likely to feel connected to the group, which in turn typically leads to greater satisfaction and reduces the likelihood that the learner will leave the environment.

Jelfs and Whitelock (2000) also found that a sense of presence was important in their work in virtual environments. Based on interviews with experts in the area of computer-based learning, Jelfs and Whitelock concluded that audio feedback is one of the most important features that can help engender a sense of presence. They also found that ease of navigation within a virtual environment can impact perceptions of presence. While the research conducted by Jelfs and Whitelock were not restricted to virtual environments enabled by the Internet, there are clear implications for what we can do in Internet-enabled contexts. Looking to incorporate audio into the interactions may have a positive impact, as would making the interface easy to navigate. The use of systems like PlaceWare® and HorizonLive®, which incorporate sound and video into Internet-based learning experiences, may prove particularly useful for future design and development work.

16.2.1.5 Other Areas to Consider. While the four constructs described above have received the most attention by researchers, there are other areas that have been explored. Saba and his colleagues (Saba, 1988; Saba & Shearer, 1994) extended the theoretical work to a systems level. Employing a systems dynamics modeling technique, Saba and his colleagues sought to gain a better understanding of learner autonomy and transactional distance. Kember (1995) created a model to explain the relationships among a variety of factors (e.g., social integration,

external attribution, GPA) and their impact on student success within the learning context.

While the work described in the paragraph above focused on extending Moore's work from the 1980s, others have looked to analyze guidelines and/or recommendations from individual design and development efforts to create theory. Levin (1995) did an analysis of individual Internet-based learning activities to suggest a theory of networked learning environments. In his theory, Levin suggests five main factors as important for Internet-based activities: structure, process, mediation, community building, and institutional support. According to Levin, each plays a critical role in successful online interactions.

Still others have looked to other theories to help inform theory for developing Internet-based interactions. For example, Leflore (2000) presents an overview of how gestalt theory and cognitive theory can be used to create guidelines for Web-based instruction. Miller and Miller (2000) describe how one's epistemological perspective (beliefs about knowledge, reality and truth) and theoretical orientation (e.g., information processing, constructivism) influence the design of Web-based instruction.

As we move forward and use of the Internet for learning continues to expand, development of a theory—or theories—to support the work remains important. Fortunately, there are techniques and methods that can strengthen and extend theory development. Grounded theory methodologies offer particular promise for this work. The grounded theory method, first made popular by Glaser and Strauss (1967) and later extended by Strauss and Corbin (1998), enables researchers to analyze and interpret their data with a goal toward building theory from it. We certainly have a growing data set from which this can occur.

16.3 DESIGNING INTERNET-BASED LEARNING ENVIRONMENTS

All goal-oriented creation is prefaced by design. In the case of moving to Internet-based learning environments, significant design and redesign work must be done to prepare face-to-face courses to survive and thrive in a networked environment. This section reviews literature related to the design and redesign of courses, assignments, and assessments, and discusses studies of online course evaluation, scalability, development, and management. It is important to note that there is a close relationship between these topics, and many studies actually shed light on more than one of the areas. Deciding which category to list each study under was troublesome and we recognize that they may overlap. Indeed, we hope that the overlap will help further illustrate the complexity of learning, particularly when it is Internet based.

16.3.1 Design and Redesign: Courses, Assignments, and Assessments

16.3.1.1 Course Redesign. Initial attempts to move courses onto the Internet were solidly grounded current practice, and generally attempted to perfectly duplicate the face-to-face class

experience online. However, instructional designers and educational researchers have begun exploring new ways of exploiting the capabilities of the Internet in their online courses, and Internet-specific course designs are beginning to emerge. This section reviews literature regarding several redesigned courses.

Arvan, Ory, Bullock, Burnaska, and Hanson (1998) redesigned and studied nine courses at University of Illinois at Urbana-Champaign using networked technology in an attempt to achieve higher student/faculty ratios without sacrificing instructional quality, the goal being to actually effect more learning per unit cost. The courses were in chemistry, circuit analysis, differential equations, economics, microbiology, Spanish, and statistics. Increases in the number of students an instructional team (faculty and teaching assistants) could serve were viewed as positive outcomes, as were decreases in the size of a team serving the same number of students. Three key strategies were employed in the redesigns: automating the grading of assignments as appropriate, using less expensive undergraduate peer tutors as graders when human grading was more appropriate, and relying on peer support. No summary information was presented regarding the difference in size between the traditional sections and the online sections taught with larger groups, though the data presented suggest that the online sections were approximately twice the size of the traditional sections. While somewhat reserved in their conclusions, the researchers report that student academic performance in the redesigned online environment is not negatively impacted when compared to parallel traditional sections, and may be improved in some cases.

Arvan et al. (1998) also presented detailed financial information for one of the nine courses. Cost savings were estimated to range between \$55 and \$209 per student in the redesigned course, depending on how faculty were compensated and how many students enrolled in the course. These cost savings were used to estimate the time required to recoup the costs of developing the new online course. In best case scenarios, the courses would be turning a profit by the end of their initial offering. In the most pessimistic scenario, approximately a year would be required before the development cost was completely recouped.

Jewett (1998) implemented the redesign of a philosophy course in an online environment using CMC technology to include more frequent personal interaction, writing, and challenging of opinion regarding philosophical works. The group of students in the restructured version of the course significantly outperformed traditional course counterparts in 8 of 16 criteria critical to philosophical discourse, no differences were found for 7 criteria, and the traditional group significantly outperformed the redesigned group on one criteria: succinctness.

Wegner, Holloway and Crader (1997) studied a redesigned traditional upper level course in curriculum design, implementation, and evaluation. According to the authors, the movement of the course to the Internet allowed Southwest Missouri State faculty to revisit the pedagogy of the course, resulting in a new online version using a problem-based approach coupled with technology-mediated Socratic questioning. Analysis of student learning outcomes for those enrolled in the new course with

outcomes from students in a traditional section showed no significant differences. Student comments about the new course design show that, while far from perfect, students appreciated the focus on real-world (non-busy-work) assignments, the sense of group they developed, gaining practical skills, and the guiding questions provided by the instructor.

16.3.1.2 Assignments. In addition to redesigning entire courses, some educators have changed individual assignments to better fit the networked nature of the Internet. And teachers aren't the only ones changing, as researchers begin to suggest that students may complete online assignments differently from in class assignments.

Schutte (2000) reports a study in which students in a social statistics course were randomly assigned to two sections, one face-to-face course and one course taught on the Web. With text, lectures, and exams held constant between the two classes, only the weekly assignments differed significantly. The face-to-face class completed and submitted a weekly problem assignment, while the virtual class had this assignment plus mandatory weekly e-mail with others in their randomly assigned work group, newsgroup discussion of a weekly topic, and IRC interactions.

The original hypothesis was that without weekly face-to-face contact with the instructor, students in the virtual sections would suffer negative consequences. Contrary to the hypothesis, results showed that the virtual class outperformed the traditional class an average of 20 percent on both the midterm and final. Virtual students also exited with significantly higher perceptions of peer contact, time spent on task, flexibility, understanding of the material, and positive affect toward mathematics. Shutte attributes the findings to virtual students bonding together to "pick up the slack of not having a real classroom," and taking advantage of the collaborative opportunities afforded by the networked medium.

Blum (1999) found evidence of differences between gender interaction and participation in discussion assignments in online environments. The results from this study were similar to previous research in face-to-face environments in some areas (e.g., males tend to dominate discussion). However, Blum also found evidence that barriers to female participation in online discussion are even higher than barriers to participation in traditional classroom settings. According to Blum, the additional barriers are a result of worries regarding technology use and the rate at which the online course and discussions progressed.

16.3.1.3 Assessment. Much of the research in online assessment has focused on automating the scoring process. Automated scoring of selected response formats such as multiple choice items has been practiced in classrooms for decades using bubble sheets. Features of the online environment afford variations on the automated scoring theme. For example, Campbell (2001) describes a "Speedback" system used to score and provide feedback for selected response items in online environments. When instructors initially create items they also create detailed feedback for each distracter to be presented to the learner should the learner choose the distracter. Campbell describes Speedback as an important factor in the cost

effectiveness of distance education in that it enables quick responses to the learner without instructor interaction.

More advanced efforts have also been made in the automated scoring of constructed response items like essays. Page's (1994) Project Essay Grade (PEG) used multiple regression with 20 variables to score 1194 senior essays. Results indicate that PEG was able to achieve correlation coefficients of .87, which was close to the reliability of the group of human judges.

Burstein et al. (1998) describe an automated essay scoring system developed by Educational Testing Service (ETS) called Electronic Essay Rater (e-rater). In this study, e-rater predicts human scores for essays written for the Graduate Management Admission Test (GMAT) and Test of Written English (TWE) using a hybrid model including syntactic structural analysis, rhetorical structure analysis, and topical analysis. The system gave the same or an adjacent score to the questions between 87 percent and 94 percent of the time.

Finally, Rudner and Liang (2002) report a study using Bayesian Essay Test Scoring sYstem (BETSY), in which Bayesian networks were used to grade essays. Bayesian networks model cause-and-effect relationships between variables by weighting each relation according to the probability of one variable affecting another. Several models were run and compared; however, the best approach combined a Bernoulli model versus a multinomial model, matching against arguments versus words or phrases, and refraining from stemming and the elimination of stopwords such as *the*, *of*, and *or*. With a training set of only 462 essays, the scoring algorithm was able to assign the same score as two human raters to over 80 percent of the set of 80 essays that were machine scored.

In addition to automating the scoring process, several issues in online assessment remain open. For example, the Internet can make transgressions from small acts of plagiarism to wholesale duplication of papers easy for students. Automated, Internet-based systems that detect plagiarism are becoming popular, but research needs to be conducted into their effectiveness. Learner authentication issues also continue to plague designers and accreditors of online programs.

16.3.2 Online Courses and Issues of Evaluation, Scalability, Development, and Management

For reasons both ethical and institutional teachers are obligated to evaluate their online course offerings. This section reviews studies regarding student satisfaction with online courses and students' perceptions of learning in online courses. Faculty satisfaction is dealt with in a later section on faculty issues.

16.3.2.1 Student Satisfaction. Rossman (1999) performed a document analysis of more than 3,000 course evaluations from 154 online courses at Capella University over 11 consecutive quarters. The design of the online courses, which are tailored specifically to adults, contained "small lectures, assigned readings," and a significant online discussion component. Three broad categories of feedback emerged from the analysis of the

online course evaluations, with specific issues in each theme including:

A. Faculty Responsibility

- 1) Learners want prompt feedback from faculty and seem to appreciate it when these comments were posted in the discussion forum in a timely manner.
- 2) Learners want specific feedback and view comments such as “nice job” or “good response” as being indicative of a disinterested or lazy faculty member.
- 3) Learners do not object to opinions being challenged as long as the individual was not belittled or humiliated for offering the response.
- 4) Learners prefer that negative comments be given privately, preferably through a phone call.

B. Facilitating Discussions

- 1) Learners appreciate and seemed to learn much from the responses of other learners.
- 2) Learner responses seem to be a valuable aspect of the course.
- 3) There is perceived guilt among some learners about not posting when postings of other learners have captured the essence of what they wanted to say.
- 4) Learners do not like it when fellow classmates did not keep current with the weekly online posting requirements.
- 5) Learners prefer discussion forums that encourage open and honest dialog; are not dominated by one or two “dominant voices”; and are not used to express non-course-related concerns or complaints.

C. Course Requirements

- 1) Learners want guidelines from faculty regarding course requirements.
- 2) Learners were dissatisfied when URLs were inoperative or incorrect.
- 3) Learners want to immediately apply information gleaned in class to life or work situations.
- 4) Learners did not like being required to purchase books, articles, various programs or other required material that were not fully utilized by the course instructor.

Rossman suggests that these evaluation results demonstrate the need for a significant shift in faculties’ understanding of their role; specifically, online teachers must focus more on facilitating learning than instructing.

Hiltz (1997) conducted a study comparing face-to-face courses with online courses offered using “Virtual Classroom” software at the New Jersey Institute of Technology. Courses taught in this mode also had significant online collaboration requirements. In a postcourse questionnaire including responses from 390 students, 71 percent of students reported that the online environment provided them with better access to their instructor and 69 percent felt that the virtual course was more convenient. Further, 58 percent indicated that they would take another virtual course and 40 percent felt that they had learned more than in their traditional classes (and 21% felt they had not). Finally, 47 percent felt that the online environment increased the efficiency of education (23% disagreed) and 58 percent said

the online environment increased the quality of education (20% disagreed).

Satisfaction with online courses is not limited to higher education. Students in secondary education are also reporting positive feedback in relation to their Internet-based learning experiences. In a similar study including four surveys across 2 years, Shapely (1999) also reports high levels of student satisfaction with an online upper-level organic chemistry course. Students compared the course favorably to other chemistry courses they had taken, and 70 percent of students said they would like to take another online course.

Not all students are satisfied with their online experiences, however. For example, Picciano (1998) reports that working adults evaluating an online class on principalship in the public schools actually reported that they would rather have been in class, citing family and workplace distractions by children and coworkers as disruptive to their studies.

Fredericksen, Pickett, Shea, Pelz, and Swan (2000) report the factors that contribute to students’ perceptions of levels of learning through the results of a survey of over 1400 students in online courses in the SUNY Learning Network (SLN). Their findings state that interaction with the teacher is the most significant contributor to perceived learning in students. Further, the study indicated that students with the highest levels of perceived learning:

- Had high levels of interaction with their online classmates,
- Participated in their online classes at higher levels than in their traditional classroom experiences,
- Had positive experiences with the supporting Help Desk,
- Chose to take the course online (as opposed to those situations where the online course was the only option),
- Were female, and
- Were in the 36–45 year age range.

The gender finding is particularly interesting in that it conflicts with the Blum (1999) study reported above, which found that women experienced significant barriers to success in online courses. Obviously the issue of gender interactions with networked learning environments warrants further study.

Wegner, Holloway, and Garten (1999) report an experimental study in which students self-selected into either an online or traditional course in curriculum design and evaluation. While evaluation results did not support the hypothesis that students in the online section would experience better academic achievement or have a more positive perception of their learning, the results did support the more conservative claim that Internet-based delivery appears to not negatively impact achievement or perception of learning.

16.3.2.2 Scalability. Scalability, the facility to go from serving a few students with online learning programs to serving very many students with such programs, is of critical concern to those involved in the design and delivery of online education. Many people generally associate scalability with the technological facility to serve large numbers of students; for example,

having sufficient bandwidth to deliver large video files or having sufficient computing power respond to large numbers of requests for web pages. Through the development of very large e-commerce sites and massive research computing clusters many of the problems with this technology side of scalability have been worked out satisfactorily. However, many of our pedagogical approaches were developed for use in a face-to-face classroom environment with 30 to 40 students. Most of the difficult scalability problems encountered in online learning relate not to the technology of networked computers, but to the pedagogy of large numbers of students. The costs associated with scaling to serve large numbers of students are also a concern. Specifics related to scalability challenges are discussed in the following paragraphs.

The cost of scaling online offerings to large numbers of students is a significant challenge. When “tried and true” face-to-face instructional models are moved online, the assumptions about appropriate faculty-to-student ratios move online as well. When this assumption is held constant, scaling to a larger number of students often means hiring additional teachers, which costs more. When faculty are paid to teach online courses on a per student basis, as Johnston, Alexander, Conrad, and Feiser (2000) found to be the case, this presents the “worst-case scenario of the future.” If the cost of educating more individuals will forever scale linearly with the number of students, one of the main promises of online education will surely fail to be fulfilled.

While automation of certain portions of the online learning experience seems to be the clear path toward scaling to larger numbers of learners online, automation is not necessarily the answer. Thaiupathump, Bourne, and Campbell (1999) studied the effects of replacing the repetitive actions carried out by human instructors (e.g., reminding students when homework is due, providing rudimentary feedback on student assignments, and notifying the instructor when students take certain actions (like submitting homework)) with similar actions performed by intelligent agents or “knowbots.” The study suggested that employing the intelligent agents significantly raised the number of assignments students completed in an online course. In two versions of the same course, with populations similar in size and characteristics, the number of assignments completed rose from 64 before the introduction of the agents to 220 afterward ($t = 5.96, p < 0.001, DF = 83$).

However, analyses of messages posted in the conferencing system suggested that the introduction of the intelligent agents actually *increased* the average facilitation time spent by the instructor per student, causing the research team to reject their hypothesis that the use of knowbots would be associated with a decrease in facilitation time. No information was reported about other time savings (e.g., time spent in grading assignments), so it is not possible to tell if there was a net loss or gain of instructor time attributable to the introduction of the intelligent agents. However, the result that automating portions of instructors’ online course responsibilities can actually increase instructor responsibilities elsewhere is worthy of further attention. While there are many researchers continuing to pursue automation of various portions of the online learning experience in order to scale it to greater numbers of learners, the path forward is not

entirely clear, and the area of scalability remains wide open for additional research and understanding.

16.3.2.3 Development and Management Tools. Development and management tools are the technical foundation of online instruction. Without facilities for uploading and storing syllabi, lecture notes, and other materials, creating quizzes, communicating announcements, and answering student questions, online instruction grinds to a halt for all but those who write their own HTML and maintain their own Unix accounts. Landon (2002) maintains a very thorough online comparison of development and management tools, including detailed descriptions of their characteristics and features. There are a multitude of smaller comparisons and published narratives regarding individual institutions’ stories of selecting official platforms for their online programs (see, for example, Bershears, 1998, or Hazari, 1998). In this section we review two broader studies describing the functions of development and management tools which students and faculty believe to be most critical to success in online teaching and learning.

The Digital Learning Environment (DLE) Group at Brigham Young University carried out an extensive evaluation of online course development and management tools as part of a campus effort to select an official, supported platform for e-learning (Seawright et al., 2000). The study began with a campus-wide survey whose findings would be used to prioritize criteria for the selection process. Findings from the 370 faculty survey respondents included ranked reports of current and intended future use of the internet for instruction. Highlights from these findings include reports that faculty were currently using the Internet mainly for communication and announcements, and posting syllabi, 47 percent intended to use “interactive learning activities” in online courses in the future, and 20 percent or more of the faculty members surveyed indicated no intention of ever putting syllabi online or communicating with students via the Internet. The DLE survey also included questions about faculty barriers to using development and management tools. The largest barrier perceived by respondents was the lack of time necessary to utilize such tools, followed by lack of funds, lack of training, and lack of technical support.

An extended usability study was performed with the three systems (WebCT, Blackboard’s CourseInfo, and WBT Systems’ TopClass) including faculty from all the University colleges representing a range of self-reported computer experience. The tests centered on faculty performing four real world tasks (upload a syllabi, create a one item quiz, e-mail a student, and post a course announcement) in a 20-minute period. All participants attempted all three systems, with the order of systems randomized to account for learning effects. The mean number of tasks completed in CourseInfo was 4.0, while the mean number of tasks completed in both WebCT and TopClass was 1.0. An ANOVA showed strong significance in the difference between the number of tasks participants were able to complete ($F = 45, p < .001$). A follow-up attitudinal survey regarding perceived ease of use confirmed these results, with CourseInfo receiving a mean rating of 3.8, and WebCT and TopClass receiving ratings of 2.3. Again, strong statistical significance was observed ($F = 49.8, p < .001$).

Halloran (2000) carried out a similar study for the U.S. Air Force Academy. Her study employed both faculty and students, all of whom self-reported as being familiar with Web-based curriculum materials. In addition to prioritizing faculty needs for development and management tools, the Halloran study included a survey of student needs. Students completed a survey rating system functions on a 6-point scale according to their perceptions of the functions' importance. The tool functions of most importance to students were access to information about their progress, an online student manual, and a tool for searching for content. As in previous studies, faculty survey responses in this study suggest that CourseInfo was again significantly easier to use than either WebCT or Intralearn, empirical investigations of the average time taken by faculty to complete a series of representative tasks in each of the three tools showed no significant differences whatsoever.

16.3.3 Continuing the Dialogue

As can be clearly seen from the studies reviewed in this section, there remains much to be done in researching the design and deployment of Internet-based courses. One study finds significant gender differences, another does not. One study finds that students prefer the flexibility of working remotely and asynchronously, another finds that students prefer to be in class. One study finds that relieving teachers of responsibility for repetitive tasks increases efficiency and even saves dollars, another finds that such relief is actually associated with faculty needing to spend even more time in their online courses. These and other contradictory results seem to indicate an inherent complexity of the educational domain as a research area, and a lack of clarity regarding the nature and purpose of educational research. It is an exciting time to be an instructional designer.

16.4 TEACHING AND THE INTERNET: UNCOVERING CHALLENGES AND OPPORTUNITIES

Designing meaningful, effective learning environments, whether on the Internet or elsewhere, is a challenging task. The hours of development work associated with the creation of the context (web pages, graphics, video/audio files, interactions, etc.) is also demanding. Indeed, many professionals are working full-time in the area of Internet-based learning and many researchers, as we have indicated in previous sections, are spending many hours exploring how to improve practices related to these endeavors.

What we would like to devote this section to is an area often overlooked in the literature: implementation. More specifically, we want to focus on one of the primary players in the implementation of many Internet-based learning events: the instructor. In the following section we will explore three topics that have been represented in the literature regarding opportunities instructors have taken advantage of as well as challenges they continue to face: professional development and shifting from face-to-face to Internet-based learning.

16.4.1 Professional Development

Professional development has traditionally received considerable attention in the technology-related literature. Entire journals have focused on professional development, with issues filled cover to cover with stories from the trenches (i.e., this is what happened to me) and a multitude of stories relaying tips and hints for how to. Many other articles and books have been published in an effort to assist instructors in their move to Internet-based learning (see, for example, Boaz et al., 1999; deVerneil & Berge, 2000; Simonson, Smaldino, Albright, & Zvacek, 2000). While this literature is important, particularly for the practitioner looking to do something tomorrow, it is not sufficient to sustain continued growth in professional development related to Internet-based learning. For growth to occur, we need insight from the research literature to guide our discussions related to professional development.

Several researchers have started the exploration of professional development in Internet-based learning. The research to date appears to be related to uncovering guidelines for professional development as well as how to support professional development via Internet-based environments. We will discuss trends in each area in the following subsections.

16.4.1.1 Guidelines for Professional Development. The research related to this area of professional development in Internet-based learning has focused on generic skills or competencies needed by faculty seeking to teach in Internet-based contexts. In the mid-1990s, Cyrs (1997) conducted a meta-analysis of the literature related to professional development and the Internet. His analysis identified four areas of general competence needed by instructors teaching via the Internet or Web: course planning and organization, verbal and nonverbal presentation skills, collaborative teamwork, and questioning strategies. While focused primarily on *courses* taught at a distance, Cyrs work remains viable for a variety of interactions via the Internet, whether short lessons/interactions or more in-depth courses.

Schoenfeld-Tacher and Persichitte (2000) explored the distinct skills and competencies required in Internet-based courses. To guide their research, Schoenfeld-Tacher and Persichitte interviewed six faculty members with experience in teaching courses via the Web. The results of their research resulted in a list of 13 skills and competencies needed by instructors when teaching via the Internet. These are summarized in the following list: familiarity with learner characteristics and needs, and how those differ from learners in a face-to-face context; application of basic instructional design; thorough knowledge of subject matter; understanding of learner-centered environments; ability to design constructivist environments; practical applications of adult learning theories, self-paced learning and computer-mediated communication; appropriate selection of Internet-based strategies for reflection and interaction; fostering a sense of community; adaptability and flexibility with media; familiarity with delivery medium; ability to multi-task; time management; and overall professional characteristics (e.g., motivated to teach, self-confident). While Schoenfeld-Tacher

and Perschitte point out that more research is needed, they have presented a good starting point for beginning a professional development effort.

Lan (2001) has also explored the general needs of instructors working in Internet-based learning contexts. Lan focused her research on interviews with 31 instructors representing 26 universities and colleges throughout the United States. Four variables were explored in the study: environment, incentives, motivation, and skills/knowledge needed to perform the task. In terms of environment, Lan found that a priori technological infrastructure was one of the highest predictors of use by instructors. Incentives were also key components for instructors; specifically, they are carrots and encourage the faculty to get involved. Motivation of instructors was also a key finding in Lan's work. As stated by Lan, "there must be convincing evidence of the value and benefits of technology" before the faculty will adopt it. In relation to skills/knowledge, Lan's found that prior technology experience was a key predictor of instructor participation in Internet-based environments. Further, she concluded that perceptions of pedagogical value were a key variable in instructor decisions to integrate technology.

16.4.1.2 Using the Internet for Professional Development. Professional development guidelines are important in our continued work to improve Internet-based learning. Exploring how to use the Internet to facilitate professional development is also important. Efforts related to this initiative are described in the following paragraphs.

Researchers have spent considerable time exploring how to build Internet-based professional development communities. One sustained effort is occurring at Indiana University. Barab and his colleagues have been working in the last few years to develop a system called the *Inquiry Learning Forum* (ILF) (Barab, MaKinster, Moore, Cunningham, & The ILF Design Team, 2001). ILF is a Web-based professional development system based on learning and community models. ILF provides teachers with a virtual space where they can observe, discuss and reflect on classroom practices [for more information see <http://ilf.crlt.indiana.edu/>]. Research is on-going, but the studies completed to date indicate that the ILF has been effective for assisting with professional development and community building.

Moore (2002) is also conducting research in the area of Internet-based professional development. Moore completed research exploring the Learning Study Group (LSG), a professional development effort focused on connecting in-service and pre-service teachers with subject-matter experts to improve educational practices. In choosing to become part of the LSG Project the participants also utilized the Inquiry Learning Forum (ILF). Moore focused her efforts on in-depth interviews and document analysis of five participants in the LSG project over a 2-year period.

In terms of their experiences with the LSG and ILF projects, Moore found that overall the participants thought the LSG project to be most profitable and engaging (in comparison with ILF), highlighting the collaborative aspects of the project and the time to focus on teaching as important aspects. Moore

reports that the participants saw "potential" in the ILF, particularly in terms of specific features (e.g., video), but reported that their participation in the online environment was not all that meaningful or useful. In general, they found their face-to-face interactions via LSG to be more useful for their day-to-day work.

Gold (2001) focused his research on the training that an online instructor needs to become an effective Internet-based teacher. A 2-week Internet-based faculty development course was examined. Participants included 44 experienced college teachers with little online teaching or studying experience. Online data collection and surveys were used to gather data to explore effects of the pedagogical training on the participants.

Gold reported two major findings. First, the research indicated that instructors exposed to the professional development course significantly changed their attitudes toward online instruction. After completing the course, instructors viewed Internet-based learning as more participatory and interactive than traditional face-to-face instruction. Second, the research indicated that after completing the course, instructors were more willing to use the online instruction.

16.4.2 Shifting from Face-to-Face to Online Contexts

Another area that has received considerable attention in the literature is related to moving from face-to-face environments to online contexts. In these studies, several factors have been explored. We will discuss four of the most prevalent factors in the following section: workload, communication, satisfaction, and cultural considerations.

16.4.2.1 Workload. Workload has received considerable attention in the literature, specifically examining how the move from a face-to-face context impacts workload in a variety of ways. Ryan, Carlton, and Ali (1999) conducted a study focusing on viewpoints related to classroom versus World Wide Web modules. A questionnaire was distributed to 96 graduate students to evaluate perceptions of their experiences in the classroom and on the Web. Several issues were raised from the results of the study, one of which related to workload. According to the researchers, the Internet-based modules required more time on the part of the faculty to respond to the students, as each student was required to respond to each topic. As a result, a group approach in the face-to-face classroom became a one-on-one approach in the Internet-based environment. The researchers indicated a need to rethink how many students might be included in an Internet-based learning context as well as how we engage dialogue in learning environments.

Kearsley (2000) has also reported on workload implications for Internet-based learning. Citing Brown, Kearsley indicates that designing a course that is highly interactive creates the high workload. Providing good feedback to students also creates high workload. While Kearsley also offers suggestions for how to reduce the workload for instructors (e.g., peer evaluation, use of teaching assistants, multiple choice tests vs. discussion), more research is needed to fully understand the ways in which we

might help reduce the amount of work associated with Internet-based learning.

16.4.2.2 Communication. One of the key characteristics of Internet-based learning is communication—asynchronous and synchronous. Researchers have explored a variety of factors impacting Internet-based communication.

Berger (1999) describes communication lessons she learned from teaching a human resource management course via the Web. The course consisted of 54 students located around the world. The course was the first online experience for Berger, although she had 10 years of teaching experience. Suggestions for management of communication were one result of Berger's experience. Recommendations include: create a single Web page for personal and professional information for all course participants; place all operational procedures for the course in one location; have students submit assignments within the body of e-mail messages instead of attachments; have students use the e-mail address to which they want responses sent, enabling easy replying; create separate folders for each course requirement to enable easy filing; and be very specific with expectations (e.g., turnaround time with messages and postings) and requirements regarding assignments so as not to confuse students.

Tiene (2000) looked specifically at the advantages and disadvantages of Internet-based discussions. Tiene surveyed 66 students involved in five graduate-level online courses over a 2-year period to find out their perceptions of online discussions. Results indicated positive reactions to most aspects of the online discussions, particularly the asynchronous aspects and use of written communication. However, when given a choice, most students indicated a preference for face-to-face discussions, noting that online discussions are useful additions to face-to-face discussions. One conclusion that Tiene draws is that instructors use online discussions to enrich face-to-face interactions when such an arrangement is feasible.

Smith, Ferguson, and Caris (2002) also focused on communication in their research. In their study, Smith et al. (2002) interviewed 21 college instructors who had taught online and face-to-face courses. Results from the analysis of the interviews indicated that instructors perceived a difference in communication style in online versus face-to-face classes. Instructors attributed the differences to bandwidth limitations, the asynchronous nature of how the courses were designed, and an emphasis on the written word. Smith et al. indicate that the differences provide opportunities and challenges. Opportunities include greater student/instructor equality, deeper class discussions and anonymity. Challenges include a need for greater explicitness in instructions for class activities, increased workload for instructors and emerging online identities for all participants.

16.4.2.3 Instructor Satisfaction. Several studies have explored learner satisfaction with Internet-based learning. We were interested in uncovering research related to instructor perceptions of their Internet-based experiences. Several studies have sought to provide insight into the positive and negative reactions that instructors have to working in Internet-based contexts (see the *Journal of Asynchronous Learning*

Networks for a comprehensive review of faculty satisfaction, <http://www.aln.org/alnweb/journal/jaln-vol4issue2-3.htm>).

A recent issue of *Distance Education Report* (2001) presented pros and cons related to instructor satisfaction in Internet-based learning. Fifty faculty members at a major university in the northeast were involved in the 2001 research study focused on uncovering factors leading to satisfaction and dissatisfaction with Internet-based learning. Results of the research indicate three key factors contributed to faculty satisfaction: reaching new audiences, highly motivated students, and high levels of interaction. Three key factors were also identified as creating discontent: heavier workload, loss of some degree of control over the course, and lack of recognition of the work associated with Internet-based work in the higher education reward system.

Lee (2001) also explored the factors contributing to instructor satisfaction. The overall purpose of Lee's research was to examine faculty perceptions of instructional support in relation to a faculty member's satisfaction in distance teaching. A survey was used to gather data from 237 faculty members from 25 institutions affiliated with the Western Cooperative for Educational Telecommunication. Lee found that the perception of support from the institution has an impact on instructor satisfaction. Further, Lee reported that in the context of insufficient support faculty tended to be less satisfied with their teaching. A clear implication is that institutional support is not only needed for logistical reasons, it is important for instructor satisfaction with the online experience.

16.4.2.4 Cultural Considerations. Internet-based learning has the clear potential for international impact unlike any other instructional medium to date. Clearly teaching and learning on a global scale is quite a different experience from one that is more situated in a local context. An area that is receiving increased attention in the research literature is the impact of cultural issues on teaching via the Internet. Research to date offers insights regarding the promise of Internet-based learning on an international scale.

McLoughlin (1999) examined the impact of culturally responsive design in the creations of an online unit for indigenous Australian learners. The model used was adapted from Lave's (1991) community of practice model. McLoughlin reported that the experience indicated that designers of Internet-based environments need to be aware of the sociocultural background and learning styles of their learners. Further, educators and designers need to respect cultural identity, participation styles and expectations of learners from various cultures. As stated by McLoughlin, it is possible to support local communities as well as to support virtual communities that include a multitude of local entities.

Cifuentes and Murphy (2000) conducted a case study exploring the effectiveness of distance learning and multimedia technologies in facilitating an expanded learning community in two K-12 contexts in Texas and Mexico. Data sources used in the research included portfolios, written reflections, and interviews. Four themes emerged from the data analysis: growth, empowerment, comfort with technology, and mentoring. Overall, the researchers concluded that powerful teacher relationships were

formed as a result of the Internet-based connections, students' multicultural understandings were enhanced, and students developed a more positive self-concept as a result of their online interactions. The project offers encouraging insights into the potential of Internet-based learning for breaking down cultural stereotypes.

16.4.3 Continuing the Dialogue

The research conducted to date related to instructors and Internet-based learning provides many insights into the challenges and opportunities associated with teaching in online contexts. We are beginning to gain insights into what is needed for professional development, both in terms of content and in relation to providing professional development via the Internet. We are also gaining a deeper understanding of the challenges and opportunities associated with shifting from a face-to-face to an Internet-based learning environment. As we continue our movement toward more Internet-based interactions for learning, we also need to continue to strengthen the research base upon which the decisions are made.

16.5 LEARNING FROM AND WITH THE INTERNET: LEARNER PERSPECTIVES

Much attention has been given to how to use various technologies to facilitate learning. The Internet is no exception. While not specifically focused on these information technologies, the arguments raised by Clark (1994) and Kozma (1994) in the early 1990s certainly offer important insights for how we think about the use of any technology for learning. Related arguments have been built around the concepts of *tutor-tool-tutee* (Taylor, 1980) and *cognitive tools* (Jonassen & Reeves, 1996; Lajoie, 1993). Jonassen and Reeves discuss the specific concepts of *learning from* and *learning with* in their work on cognitive tools. These concepts are described in more detail in the following paragraphs.

The *learning from* perspective is grounded in a behaviorist view of learning that proposes that information is transmitted from the medium and absorbed by the learner (Hayes, 2000). The learner's role in the *learning from* model is passive with occasional and limited interaction. The teacher's role in the *learning from* model is that of manager—managing the use of the preestablished, often “teacher-proof” content. When *learning from*, the Internet is a vehicle for the delivery of information (Kozma, 1994).

Learning with the Internet is a perspective founded in constructivist (Piaget, 1954; von Glasersfeld, 1993, 1989) and constructionist (Harel & Papert, 1991; Kafai & Resnick, 1996) principles of teaching and learning. *Learning with* moves the orientation from passive learning to one of active creation. The effectiveness of *learning with* technology is a function of the skills and experience learners have with it and the degree to which curriculum has been designed to support desirable pedagogical dimensions (Reeves, 2002, personal communication).

The learner is no longer solely taking the information; s/he is also contributing to the knowledge base, designing and creating artifacts that enable the learning process to occur (Perkins, 1986).

In the following section we will explore two primary threads of arguments that have been presented by researchers regarding strategies for how the Internet can/should be used for *learning from* and *learning with* in educational settings. To facilitate the discussion, we will look at three subtopics closely tied to *learning from* and *learning with*: learner characteristics, activities, and achievement with the Internet. We will focus our review on research related to learners and how they are engaged in *learning from* and *learning with* the tool (see section four in this chapter for research related to the instructor).

16.5.1 Learner Characteristics

Learner characteristics have received considerable attention in the literature related to the use of the Internet for learning. We will focus on three specific constructs: learners as receivers of information, learners as information users and creators, and demographic traits.

16.5.1.1 Learners as Receivers. The primary role played by learners when *learning from* the Internet is that of receiver. The learner is reading and viewing information provided by others. This may sound a simple task; indeed, it is a modality that continues to predominate our educational infrastructure. However, there are many underlying variables that need to be taken into consideration in facilitating learners as receivers. These variables are explored in the following paragraphs.

One variable that has received considerable attention in relation to learners as receivers is that of evaluation of information. Although the learner may not be actively creating the resource, they do need to be actively engaged in evaluating the viability and reliability of the resource. Fitzgerald (2000) did an extensive study of university-level students' evaluation of information and found that there are many factors that influence information evaluation, including: prior knowledge, format of information, and epistemology. Fitzgerald also found that emotions, beliefs, and metacognition were influential factors in evaluation. While work like Fitzgerald's assists us in developing a greater understanding of the information evaluation process and where we need to focus when helping learners evaluate information, we still have more work to do. As stated by Fitzgerald: “Evaluation [of information] is messy and complex” (p. 184). Working to make the evaluation activity less complex will be an important area of research in the coming decade.

Interpretation of the information is another important variable when the learner is the receiver of information. Research conducted by Hill and Hannafin (1997) with a group of university-level graduate students indicated that there are several factors that impact how information is interpreted once it is found during a search. In the Hill and Hannafin study, students selected the topic and searched for information using a search engine on the Web. Results concluded that even when the information presented would appear to address the students'

self-stated need, they would often not see it as relevant. Hill and Hannafin concluded that this disparity in interpretation could be attributed to several factors, including prior knowledge and metacognitive knowledge. In related work, Yang (2001) found that students' attitudes and perceptions also played a role in the interpretation of information during information seeking. How the students approached the task influenced their perceptions of the activity.

Use of the information is also a variable that has been considered in research related to *learning from* the Internet. For example, Doring (1999) emphasized that the use of information in the production of knowledge was a key component in the retrieval process. As users seek information, they have in mind how that information will be used. This, in turn, influences what they view as relevant and useful in the overall effort.

16.5.1.2 Learners as Information Users and Creators.

In learning with the Internet, learners become users of the information as they actively construct their understanding and create artifacts to represent the understanding. Many types of products have been used to help facilitate the representation of understanding.

Perhaps one of the most widely known tools is the Webquest. Webquests (Dodge, 2001, 2002; Yoder, 1999) are another formal learning tool that has been used in a variety of contexts to meet the information needs of students and teachers. Webquests have been used in social studies to assist learners with understanding Latin American contexts (Milson, 2001), in math to teach probability (Arbaugh, Scholten, & Essex, 2001), and in language arts to teach literature, library and computer skills (Truett, 2001). Webquests have also been implemented across grade levels, with children and adults.

To date, the majority of Webquests have been constructed by teachers and then used by students. Research related to teacher-directed implementations indicates that Webquests are a success (see, for example, Dutt-Doner, Wilmer, Stevens, & Hartman, 2000; Kelly, 2000). However, recent research indicates that a more constructionist approach can be used to place students in the position of designer of the Webquest. Peterson and Koeck (2001) found it very effective to have students construct Webquests in a chemistry course to explore nuclear energy in the 21st century. Results from Peterson's and Koeck's research indicate that students engaged in intellectual struggles to solve problems, created interdisciplinary connections as they constructed their Webquests, and used the technology as a tool to communicate meaning. While more research is needed in this area, the prospect of students as developers of Webquests is encouraging.

16.5.1.3 Demographic Traits. Specific learner traits have also been explored in the research. Gender is one trait that has received considerable attention. Stewart, Shields, Monolescu, and Taylor (1999) looked at the impact of gender on participation within a synchronous learning environment employing Internet Relay Chat (IRC) as the delivery technology. Seventeen undergraduates enrolled in a course in a university in an urban area in the United States. Stewart et al. (1999) examined gender differences in the following areas: online participation, language

styles, computer skills, socialization, attitudes, and prior experience. Results indicated that participants were similar in background and experience levels as well as attitudes toward technology. However, the researchers found significant differences in the amount and type of communication by gender. Men sent more and longer messages than women. They also found that men tended to look at the task as more of a game, with the women taking the task more seriously. Further, the men tended to take control of the discussion, while women tended to work toward agreement in the discussions.

Two other specific characteristics have been explored in the literature: culture and disabilities. Although neither characteristic has received as much consideration as other characteristics, we feel the need for further exploration of these constructs will continue to increase. A study was conducted by Wilson (2001) to explore the potential impact of text created by Westerners for West African students. Wilson specifically sought to develop understanding of the impact of cultural discontinuities on learning. In this qualitative study, Wilson discovered that several cultural discontinuities existed, including: differences in worldviews, culturally specific knowledge and conceptualizations, first-language linguistic challenges, and reading cognition profiles. Further, Wilson discovered that the discontinuities had an impact on learning for the native language speakers. Wilson's research helps provide an insight into the importance of culture, providing insights into the viability of globally based Internet learning.

Fichten et al. (2000) explored issues related to disabilities and Internet-based learning. Fichten et al. specifically explored access issues in relation to physical, sensory, and learning disabilities. Using focus groups, interviews and questionnaires, the researchers gathered data in three empirical studies. Results from the studies indicated that learners made use of the Internet for learning, however physical adaptation of the technology was needed to enable effective use.

Many studies examining use of the Internet for learning have explored multiple learner characteristics within the same study. For example, Hargis (2001) examined a variety of learner characteristics in her study of the use of the Internet to learn science. An objectivist and constructivist instructional format was created online. Both contained the same content. Specific characteristics studied in the research included: age, gender, racial identity, attitude, aptitude, self-regulated learning and self-efficacy. No significant differences were found with specific variables, with the exception of older participants performing better using an objectivist approach. Hargis concluded that individual learner characteristics should not be barriers to Internet-based learning.

16.5.2 Supporting Learner Activities in Online Environments

Learners are often engaged in several activities when learning from or with the Internet. Further, these activities often occur simultaneously. In this subsection, we explore four specific activities: information gathering, knowledge construction, use of distributed resources and distributed processing.

16.5.2.1 Information Gathering. While this topic is covered more in-depth in another chapter in the book, it would be remiss not to mention it here within the context of learners and *learning from*. Information gathering is a critical activity in the *learning from* model of using the Internet and Web for learning. In fact, research indicates that information gathering is perhaps the most widely used application of the Internet (Hill, Reeves, Grant, & Wang, 2000). And with the continued exponential growth in available resources, it is likely to continue to be one of the most widely used applications of networked technologies.

What are we doing when we are gathering information on the Internet? According to Hill (1999), learners are engaged in a variety of activities, including purposeful thinking, acting, evaluation, transformation and integration, and resolution. Fitzgerald (2000) points out other processes that are occurring as we seek information. According to her research with adult learners at the university level, learners evaluate, analyze, choose, critique, construct, argue and synthesize. Clearly, the gathering of information is a complex cognitive task that has many rewards, but as a complex activity, it also has the potential to create significant challenges.

One significant challenge indicated by the research is the potential of getting lost in hyperspace. Marchionini's work in the late 1980s through the mid-1990s documented the information seeking process, including the impacts of getting lost, as users worked in various information systems. This work culminated in his book, *Information Seeking in Electronic Environments* (Marchionini, 1995). Marchionini concludes that we need to work to create "... positive and natural [systems] rather than sophisticated workarounds" (p. 196) so that learners can have an easier time with locating and using the information they find.

This appears to be a proposition that is easier said than done. More recent research indicates that the potential of "getting lost" continues to be a challenge for information gathering. In a study with learners in a technology-based course, Hill and Hannafin (1997) found that learners struggled to keep track of where they were and what they were looking for within a Web-based information context. Indeed, results indicated that learners often got "lost" and then struggled to figure out where they were and what they were looking for to begin with. Hill (1999) also discusses the struggles faced by learners as they seek information in open-ended information systems like the Internet. This challenge continues today. How to make systems more "positive and natural" remains an area in need of further research.

Another challenge relates to support. As pointed out by Hill (1999), information gathering needs to be well supported if learners are to be successful in the task of information retrieval. Several researchers have posed potential solutions to the challenges associated with information seeking. Some researchers have focused on strategies related to the learners themselves. Fornaciari and Roca (1999) pose that there are several strategies that learners can use to help facilitate the information seeking process, including: "... defining problems effectively, determining information needs, identifying and evaluating information, and questioning source credibility and quality" (p. 732). Pirolli and Card (1999) likened information seeking behavior

to foraging for food with an "information foraging theory," in which they proposed that people "modify their strategies or the structure of their environment to maximize their rate of gaining valuable information" (p. 643).

Other researchers have focused on how to use technology to assist with the process. For example, Baylor (1999) has conducted research using intelligent agents to assist with information retrieval and overload. Baylor concluded that intelligent agents can indeed be useful for assistance. Other researchers have examined specific characteristics related to the interface to help the learner with the information seeking process. Cole, Mandelblatt, and Stevenson (2002) as well as Heo and Hirtle (2001) indicate that visual schemes appear to be promising for assisting learners with information seeking and not getting lost in the overwhelming amount of information.

16.5.2.2 Knowledge Construction. While *learning from* entails the somewhat passive use of resources found on the Internet, *learning with* extends the effort to one of construction. The learner is actively involved in constructing something unique based on what is uncovered as they use the Internet for information gathering. The learner is not only engaged in retrieving the information; s/he uses it to solve problems (Simon, 1987).

When the Internet is used to facilitate knowledge construction it becomes what Jonassen and Reeves (1996) refer to as a "cognitive tool." Cognitive tools are technologies (tangible or intangible) that "... enhance the cognitive powers of human beings during thinking, problem solving, and learning" (p. 693). When used as a cognitive tool, the Internet becomes a tool for creation that enables the learner to express what they know; that is, it becomes a technology of the mind (Salomon, 1994).

Kafai and Resnick (1996) also describe the power of knowledge construction in their work. According to Kafai and Resnick, when learners are engaged in developing representations of what they know, it can lead to a greater level of understanding. Learners become creators of rather than consumers of; communicators versus receivers. When learners are full participants in the learning process, from planning to evaluation of the process, personally meaningful learning is viable in ways not possible prior to now.

One well-researched environment for knowledge construction is Slotta and Linn's (2000) Web-based Knowledge Integration Environment (KIE). In one research project related to KIE, eighth graders were asked to evaluate Web sites related to passive solar energy. As the students evaluated the sites, they were also asked to address questions that would assist them in creating knowledge, relating the Web site content to a specific project. Results indicated that with the use of scaffolding tools, students were able to generate knowledge and ask critical questions of the content.

In another study related to Web-based contexts, Linn and her colleagues (1999) explored the use of the Web-based Integrated Science Environment (WISE), seeking to find out how student analyze information and create knowledge within the system. Researchers found that students were able to successfully analyze scientific content related to why frog mutations

occur. Further, they also found that students with low academic performance demonstrated gains in cognitive engagement.

16.5.2.3 Use of Distributed Resources. The Internet has enabled access to millions of resources, distributed on a global scale heretofore impossible. These resources are like “knowledge bubbles” that learners and teachers encounter as they are moving through virtual space. A resource-based structure is not a new pedagogical innovation (see Haycock, 1991), however interest has grown over the last few years in terms of how to take advantage of the rich amount of information now available (see, for example, Hill & Hannafin, 2001; MacDonald & Mason, 1998).

Research related to the use of resources in Web-based environments have provided some insight into how resources can be used for learning. Research conducted by Slotta and Linn (2000) explored how eighth grader’s used Web resources during a learning task. Their findings indicate that when students are provided orientation and ongoing scaffolding on the use of the resources and tools, they perform quite effectively on the task. These findings were similar to what Oliver (1999) found in his research related to Web-based learning environments. Oliver concluded that students need orientation and guidance for effective use of the available resources.

While the prospects are exciting, the implications in our current context can be somewhat daunting. As stated by Hill and Hannafin (2001), “. . . current [educational] practices may prove insufficient in optimizing available resources. . . .” (p. 37). Defining strategies that will enable the efficient and effective use of the multitude of electronic resources is an area in need of further exploration.

Distributed resources also create challenges from a standardization perspective. Standards and tools for sharing resources are emerging (e.g., SCORM, IMS), yet they are not adhered to nor systematically applied in all areas (Hill & Hannafin, 2001; Robson, 2002). We need to find ways to enable the creation of mechanisms that allow for flexible retrieval and use of resources within a structured context. Research to date has been limited. However, investigations underway by Wiley (2000) promise to provide insight into how resource distribution might be accomplished.

16.5.2.4 Distributed Processing. One of the benefits often associated in the *learning with* literature relates to the notion of distributed cognition. According to Pea (1985), media can become cognitive technologies if they assist learners to overcome limitations (e.g., limits on memory, problem solving). With the vast number of resources and relative ease associated with resource creation, the Internet has the potential to assist learners with cognitive challenges associated with memory, knowledge creation, and problem solving.

In addition to assisting with cognitive challenges, distributed processing also enables the establishment of intellectual partnerships through the sharing of cognitive artifacts. The sharing of artifacts can happen in real-time (e.g., in synchronous chat rooms, virtual conferencing) or asynchronously (e.g., posted Web pages, bulletin board interactions). By sharing artifacts—either created individually or collaboratively—learners are

adding to the knowledge base, thereby further extending the capabilities of the system and the individuals using the system (Perkins, 1993).

This area has received considerable attention in the literature, particularly at the university level. Brush and Uden (2000) found that distributed processing worked well in two university instructional design courses. Students worked with each other in two different countries to create products and provide feedback. Students reported that when the collaboration occurred they worked well, although the researchers indicated that participation could have been much higher.

Distributed processing has also been explored in the area of assessment. Kwok and Ma (1999) researched the use of a Group Support System (GSS) for collaborative assessment of student projects in an undergraduate Distributed Information Systems course. To explore the use of the GSS, Kwok and Ma set up two groups: one group that used the tool online and one group that met face-to-face. Results indicated that the students that used the GSS had a higher level of “deep approach” strategies to learning and better project grades. While not conclusive, the use of tools like the GSS appears to be promising.

Distributed processing does not come without challenges. For example, the very nature of the activity creates a dependence on others for the information needed. If others in the environment have not shared their information and/or encouraged others to do so, it may well be that the information will not be accessible when needed. This can lead to frustration on the part of the learner.

Another challenge associated with distributed processing is the time it can take to get others to respond. While one user may be a frequent and thorough responder to e-mail, bulletin board postings, etc., another may have a completely different work style. Providing guidelines for response times can go a long way in reducing potential frustration (Hill, 2002). Other research suggests that this problem diminishes in proportion to the size of the community (Wiley & Edwards, 2002), although more research is needed to gain a more complete picture of why this occurs.

16.5.3 Achievement in Internet-Based Learning Environments

Achievement is another variable often explored in Internet-based learning. This construct has been explored in formal and informal environments, looking at both intentional and incidental learning. We will explore the research in this area within two subsections: required learning and meaningful learning.

16.5.3.1 Required Learning. There is a reality in our educational practice that some things are just required in terms of learning. Basic facts related to English, history, math and science continue to be taught by teachers and memorized by students in schools, and are valued in the larger social context. The resurgence of interest in standardized curriculum and testing is placing considerable emphasis on required learning, and does not look to be diminishing in the foreseeable future.

The *learning from* model of using the Internet offers considerable promise in assisting teachers and learners with required learning activities. Researchers and developers have been working on creating Web sites to assist teachers in finding the resources they need that will assist with matching instruction to standards and other requirements. For example, Peck and his colleagues at Penn State have created a Web portal that links national standards, resources and tools together for teachers to use in their classrooms (for more information, see <http://ide.ed.psu.edu/aectweb>). This system is grounded in some of Peck's (1998) earlier work in which he sought to show connections between standards and the use of technology in schools. Initial review of the system has been positive, although formal research has not yet been published.

Studies have also explored how students have performed in online environments versus other types of learning environments (e.g., face-to-face, television). The vast majority of the studies report no significant difference in terms of achievement (see Russell, 1999, for a comprehensive review). However, many of the studies are reporting differences in other areas. These are described in the following paragraphs.

Ostiguy and Haffer (2001) conducted a study in a general education science course exploring academic achievement in a face-to-face course versus other delivery modes. While they did not find differences in achievement, they did find differences in interaction levels. Students enrolled in the television and Web-based versions of the course reported greater levels of interaction with the instructor. Further, they were also more likely to report dissatisfaction with the interaction when it was less than they wanted.

Sinyor (1998) also found that the Internet did not greatly facilitate achievement. Sinyor studied 74 students involved in three intermediate and advanced Italian second language classes. Results from her study indicated that while the Internet was useful as a source of information, specific resources for learning Italian were inadequate and limited. In this instance, the Internet did not meet the needs for required learning.

Despite the majority of studies reporting no significant differences in achievement, there are some studies indicating an impact on performance. For example, in a study of a middle school atmospheric science program, Lee and Songer (2001) reported an improvement in performance. Students involved in the study were involved in an Internet-enhanced version of the program. Using discourse analysis of electronic messages between students and scientists as well as interviews and a teacher survey, Lee and Songer reported that students had an enhanced understanding of atmospheric science following their involvement in the program.

Research by Gilliver, Randall, and Pok (1998) indicated an impact on performance in a college in Singapore. Gilliver and his colleagues examined the use of the Internet as an adjunct to learning in an undergraduate financial accounting course. Results indicated that the examination scores of those using the Internet as a learning supplement were superior to those who did not use the electronic version.

Follansbee et al. (1997) also found an increase in performance. Follansbee et al. (1997) explored the use of the Internet, with an emphasis on the use of the Scholastic

Network, on student learning. Using a quasi-experimental design, results indicated that students in experimental classes produced better results on a civil rights unit than those in the control classes.

There are also studies reporting both positive and negative impacts of the Internet on learning. Ali and Franklin (2001) conducted a study of 22 undergraduates enrolled in a technological applications in education course. The study focused on one-on-one interviews, participant observation and a survey. Results from the Ali and Franklin (2001) study indicated several positive and negative influences on learning. Positively, participants reported the Internet enabled access to vast resources, provided opportunities for independent and individualized learning via online tutorials, created opportunities for in-depth learning, and increased motivation. On the negative side, participants reported the Internet created interference with concentration in class; was time consuming, both in terms of finding information and assessing it; and created a dependency on the network for information, even when it may have been inappropriate to use the Internet to find information.

16.5.3.2 Meaningful Learning. A construct that is central to the *learning with* model is that of meaningful learning. When learning is meaningful, it is student-centered, focusing on the needs and intents of the individual learner (Hannafin, Hill, & Land, 1997). According to Jonassen and Reeves (1996), meaningful learning is critical to the cognitive partnership inherent in the *learning with* approach.

Meaningful learning occurs within authentic contexts (Kafai & Resnick, 1996). Unlike more traditional approaches in which learning occurs in an isolated classroom, meaningful learning is grounded in the "real world" context in which it occurs. The authenticity of the activity is also critical to meaningful learning. According to several researchers (Brown, Collins, & Duguid, 1989; Greeno, Smith, & Moore, 1992), knowledge created while involved in authentic activities is more readily transferred to different contexts than when the activities are abstract. Cognitive apprenticeship (Collins, Brown, & Newman, 1989), anchored instruction (Cognition and Technology Group at Vanderbilt, 1992), and problem-based learning (Barrows, 1986) are often associated with meaningful learning.

When learners are engaged in meaningful learning, they are defining the goals and/or context in which the learning will occur. Because they are creating it, they own it. The creation/ownership link enables a different level of thinking and understanding—one that is likely to enable a more fulfilling learning experience (Kafai & Resnick, 1996).

One example of research related to meaningful learning is found in the Teaching as Intentional Learning program. Moss (1999, 2000) has been actively involved in the creation of and research related to the Teaching as Intentional Learning (TIL) program at Duquesne University in Pennsylvania. TIL is a part of a larger research effort investigating "... professional learning, reflective practice, teacher beliefs, teacher inquiry and the role of technology in learning environments" (Moss, 2000, p. 46). As stated by Moss (2000), teachers involved in the network (over 400 worldwide) come with the goal of revealing, examining and challenging the assumptions that underlie their

teaching practice—with the intent to improve that practice as “scholarly practitioners.” Moss’ ongoing research in this area is an important step in bringing the examination of intentional learning into online contexts.

Incidental learning has also received some attention in *learning with* contexts. Baylor (2001) conducted a study in which she examined the incidental learning of adult learners during a search task in a Web environment. Initial results indicated incidental learning did occur, particularly in the absence of distracting links. Oliver and McLoughlin (2001) also explored incidental learning within a Web-based context, focusing their attention on the acquisition of generic skills (e.g., self-management, task, information). Like Baylor, Oliver and McLoughlin’s (2001) results indicate that the generic skills were acquired as a result of working within the learning environment, although this was not the focus of the environment. While more research is needed, these initial studies are an important contribution to the examination of incidental learning, an area of study that has proved challenging, particularly in terms of measuring “real world” incidental learning that occurs within a meaningful context (Kelly, Burton, Kato, & Akamatsu, 2001).

16.5.4 Continuing the Dialogue

Use of the Internet for learning—from or with, intentionally or incidentally—has grown exponentially in the last 5 years. We have also greatly enhanced how we are using the tool. However, issues and questions remain that continue to impact the long-term viability of Internet use for learning. Gibson and Oberg (1997) conducted a case study research project in Alberta, Canada exploring how schools were using the Internet, how teachers were learning to use it, and perceptions of its value as an educational tool. While the study is somewhat dated, and while use and access have certainly changed in the years since the data was gathered, many of the issues uncovered in the study remain relevant. For example, quality of information found on the Internet remains a concern as does the control of access to information. Other areas that call to question the viability of the Internet for learning include: impact of standardized teaching on resource use in the classroom, robustness and reliability of the network, and shifts in expectations (for the teacher and learner) associated with Internet-based learning. Examination of these issues, along with many others, will provide a foundation for research well into the future.

16.6 LEARNING THROUGH THE INTERNET: INTERACTIONS AND CONNECTIONS IN ONLINE ENVIRONMENTS

Perhaps the most pervasive research area related to the use of the Internet for learning in the last 5 years has come in the area of interaction, particularly in the form of interpersonal exchanges. According to Schrum (1995), high levels of interactivity helped drive the popularity of the Internet as an instructional medium when it first started—and this has continued today. The tool has

been used in a variety of ways to facilitate learning. Harris (1995) discussed six types of interpersonal exchanges transpiring on the Internet:

- *Keypals*: individual students in two or more locations matched with each other for discussion via electronic mail,
- *Global classrooms*: two or more classrooms in two or more locations studying a common topic together,
- *Electronic “appearances”*: newsgroups or bulletin boards sponsor special guests with whom students correspond,
- *Electronic mentoring*: one-to-one link between an apprentice and an expert for purposes of providing guidance and answering questions,
- *Question and answer services*: questions are submitted and then answered by a subject-matter expert, and
- *Impersonation activity structures*: any—or all—participants communicate with each other “in character” fitting the topic under discussion.

Researchers continue to talk about the uses described by Harris, as well as other applications, including the use of e-mail with students to assist with motivation and greater academic achievement (Miller, 2001), e-mail mentors to connect girls with professional women for career advice (Duff, 2000), facilitating learning via e-mail games (Jasinski & Thiagarajan, 2000), using listservs to facilitate brainstorming and creativity (Siau, 1999), using e-mail for collaborative projects (Buchanan, 1998), and extending deaf students’ access to knowledge through the use of listservs (Monikowski, 1997). These activities are well aligned with the review of research reported by Berge and Mrozowski (2001). In their review, Berge and Mrozowski indicated the emphasis placed on the use of a variety of technologies to support interaction. Research is also focused on the type of interactions occurring as well as how best to use the tools to facilitate these interactions. We explore this research in the following sections.

16.6.1 Instructor–Learner and Learner–Learner Interactions

Traditionally, three types of interaction are described in distance or Internet-based learning: instructor–learner, learner–learner, and learner–content (Moore & Kearsley, 1995). While research has examined all three areas, the majority of the current research has focused on human interactions involving instructors and learners. In the following paragraphs, we will examine three specific areas of research related to human interactions: identity, communication challenges, and factors influencing interactions.

16.6.1.1 Identity. When individuals prepare to interact with others online, whether for learning or other social reasons, they must project an identity into the interaction space. Online conversations frequently entail identity-probing questions such as “a/s/I everyone?” in which individuals are asked to self-disclose their age, sex, and location (Barzeski, 2002). Yet research is

confirming what many have already experienced: self-disclosures online regarding identity are sometimes purposely deceptive (Donath, 2002). When being someone else is so simple, individuals may attempt to manipulate this ease of deception toward their own academically dishonest ends (e.g., portraying him/herself as a professor).

Aside from purposive deception with regards to identity, Gergen (1991) has argued that the Internet has led to the “social saturation” of individuals. E-mail, chat, the web, and other technologies expose each of us to more people of greater variety more frequently than humans have ever interacted with before. This broad and frequent exposure to individuals and viewpoints can make appropriate attribution (i.e., citation of ownership of ideas) difficult. Indeed, the notion of what type of attribution is appropriate online appears to be changing. Questions of identity as they relate to assessment strategies and citation must be dealt with before the Internet can be deployed more broadly within formal educational environments.

16.6.1.2 Communication Challenges. Internet-based interactions are primarily text based, relying on many of the conventions associated with written communication. However, because of the ability to rapidly exchange the text-based information in chat rooms or with instant messaging, the interactions can also resemble verbal communication. This hybrid form of communication creates several exciting opportunities as well as several challenges.

One challenge relates to the temporal gap associated with sharing information in Internet-based learning contexts. Researchers have started exploring the impact of this gap on the learning and interaction processes. Garcia and Jacobs (1999) concluded that chat systems, a popular Internet-based tool used to facilitate communication, are “quasi-synchronous” communication tools. According to Garcia and Jacobs (1999), chat messages primarily serve the composer of the message in terms of the communication process. While only a slight delay in providing a reply in many instances, the delay creates a shift in the dialogue structure.

The expository nature of communication is another challenge associated with Internet-based learning. Fahy, Crawford, and Aely (2001) explored the communication patterns of thirteen students enrolled in a 15-week online graduate course. Communication was facilitated by several Internet-based tools: e-mail, file sharing, and a conferencing application. Fahy et al. explored the interactional and structural elements of the interactions using the Transactional Analysis Tool (TAT).

Results from the TAT analysis revealed that the size of the network has an impact on the level of involvement. That is, as the network grew, the number of links to other messages also grew. Overall, the researchers found that levels of participation and connectedness of participants varied considerably, and intensity and persistence of participation among individuals were unequal. The majority of the students’ contributions were direct statements, with the next largest category being reflections. Thus the focus of the “conversation” was on transfer of information rather than a dynamic dialogue. The challenge of assisting students with learning how to communicate

in dynamic ways using Internet-based technologies remains largely unexplored and an area in need of further investigation.

Facilitating dialogue in any learning context is certainly important, and many researchers have explored ways to support and facilitate dialogue. Gay, Boehner, and Panella (1997) explored how to support online learning through conversations. ArtView, developed by the Interactive Multimedia Group at Cornell University, was designed to enable learners to converse in a shared space while viewing art-related images selected by the instructor. Gay et al. (1997) examined the effectiveness of this tool in a college art course. Learners enrolled in the course were asked to compare and contrast their experience with ArtView to a face-to-face guided visit and discussion in an art museum.

Participants reported limitations as well as positive aspects to the application. Limitations of ArtView included a lack of personal choice of what to view as well as a lack of an outstanding physical viewing environment. They also mentioned the limitations of the 2-D display of the images. Despite the limitations, Gay et al (1997) reported that most participants reported that the limitations were outweighed by the quality and convenience of the online tools.

16.6.1.3 Factors Influencing Communication. Interaction and communication are impacted by several factors. Researchers have been exploring specific interactions in an attempt to define exactly what the factors are so that we might better understand how to accommodate needs and enable enhanced communication in Internet-based learning environments.

Vrasidas and McIsaac (1999) examined interactions in a blended delivery graduate course that involved face-to-face and Internet-based communication. Eight learners and one instructor participated in the course. The researchers used several sources of data to inform their results: observations, interviews, course work, and online messages. Results indicated that course structure, class size, level of feedback and prior experience of the learners influenced communication in the course. Participants also indicated that their understanding was influenced by group interactions; yet the researchers indicated a lack of interaction in asynchronous discussions. Finding ways to assist learners in becoming comfortable in communicating in multiple venues may facilitate increased understanding.

Wolfe (2000) focused her work on communication patterns of college students in a blended environment as well. In this study, the researcher focused on two specific characteristics: ethnicity and gender. Wolfe (2000) found that white male students participated more in the face-to-face class interactions, while the white female students benefited from the Internet-based communication tools. Wolfe also found that Hispanic female students participated frequently in face-to-face interactions, speaking more than their male counterparts, and, in general, disliked the Internet-based interactions.

16.6.2 Facilitating Interactions: Strategies and Tools

In addition to uncovering specific factors that impact communication, researchers have also attempted to discover strategies

and tools that assist and facilitate interaction in Internet-based learning. We discuss these techniques in three main areas: collaboration strategies, discourse strategies, and tools.

16.6.2.1 Collaboration Strategies. Collaboration is a strategy frequently used to facilitate interactions in Internet-based learning. In a collaborative model, learners are not working in isolation. Rather, they are working with others to extend their own learning, as well as to help facilitate the learning of others. As a result, the orientation changes from what *I* know to what *we* know.

According to Slavin (1990), the social construction of knowledge enables a deeper level of processing and understanding than could occur on an individual level. With its extensive communication capabilities, the Internet readily facilitates collaboration. Internet-based technologies such as e-mail, listservs, and chat rooms enable content to be pushed to learners on a local or global scale. Web-based tools such as web boards virtual classrooms, and blogs extend and enhance communication capabilities, extending the opportunities for collaboration amongst and between learners (Sugrue, 2000).

Oliver, Omari, and Herrington (1998) explored the collaborative learning activities of university level students engaged in an Internet-based learning environment. The researchers found that the environment, based on constructivist principles, encouraged cooperation and reflection amongst and between participants. Oliver et al. (1998) found that specific elements influenced collaboration within the course: group composition and specific collaborative components. Results also indicated that having suggested roles for group members influenced collaboration.

By collaborating using the Internet, learners have the capabilities to engage in dynamic meaning-making (Hooper-Greenhill, 1999). According to hermeneutic theory, meaning is created through the hermeneutic circle involving continuous activity and movement. Hooper-Greenhill (1999) explains this process as follows: "... understanding develops through the continuous movement between the whole and the parts ... and ... meaning is constantly modified as further relationships are encountered. ... The process of constructing meaning is like holding a conversation ... [and] is never static" (p. 49).

The use of a strong theory to guide research was also found in research by Cecez-Kecmanovic and Webb (2000a, 2000b). Habermas' theory of communicative action was used to create a model of collaborative learning that was used to analyze the data gathered during the study. Based on their analysis, Cecez-Kecmanovic and Webb found that the model assisted them in uncovering what was said and how it contributed to the conversation. This is an important finding in that more robust models are needed to assist with the analysis of online discourse in terms of learning.

Many researchers have explored the challenges associated with collaboration and group work within Internet-based contexts. Bruckman and Resnick (1996) describe one of the first online professional communities, MediaMOO, established using an Internet technology known as a MUD—a multiuser dungeon. According to Bruckman and Resnick, MediaMOO was a text-based, networked, virtual reality environment designed to

facilitate member-created and organized projects and events. Within this context, users decided what to build and when to build it, encouraging self-expression, diversity, and meaningful engagement.

More recently, attention has turned to the development of computer-supported collaborative learning (CSCL). In CSCL environments, online groups are used for instructional purposes. Brandon and Hollingshead (1999) provide a nice overview of some of the research on CSCL environments, including associated benefits and challenges. Benefits include: increased student responsibility, greater opportunities for communication, potential for increased learning, and preparation for work in virtual teams. Challenges include: reconciling technological, pedagogical, and learning issues; and becoming adept at creating activities that involve CSCL environments. Brandon and Hollingshead (1999) conclude with the presentation of a model for the creation of effective CSCL groups, which includes the interaction of collaboration, communication, and social context.

16.6.2.2 Discourse Strategies. Expert intervention and group formation seem to impact discourse in Internet-based learning. Daley (2002) analyzed over 450 contributions to an Internet-based discussion by 52 adult learners. Results indicated that interactions progressed to a high analytical level, which Daley attributes to group process development. She also indicates that communication was supported by faculty synthesizing and linking contributions for learners. This intervention by the faculty might indicate to learners that the faculty member values Internet-based communication, thus adding to motivation levels and contributions to the discussion. The significance of the faculty's framing of the importance of the Internet-based interactions was also corroborated in another study. Yagelski and Grabill (1998) found that the ways in which the instructor framed and managed the uses of Internet-based technologies impacted rates of student participation. It also had an impact on students' perceptions of the importance of the technologies within the learning context.

The importance on the value of assisting participants in learning how to communicate in Internet-based dialogue has been discussed by several researchers. Werry (1996) and Hutchby (2001) discuss the value of speaking directly to or addressing individuals in Internet-based discourse. Addressing involves putting the name of the person being addressed at the front of a message or post. This enables everyone engaged in the dialogue to understand the order of communication.

Edens (2000) evaluated the use of an Internet-based discussion group with preservice teachers. Edens specifically sought to explore how the use of such a group might strengthen communication, inquiry, and reflection. While the group did benefit the students in that they communicated observations and concerns across grade-level placements, Edens pointed out that there were pitfalls encountered, one of which was the importance of fostering communication and reflective inquiry in Internet-based discussion groups.

Hill (2002) also described the importance of monitoring activities to facilitate discourse based on her research in community building. Hill (2002) found that facilitation of Internet-based

dialogue, either by the instructor or peer participants, had an impact on the perceived value of the interaction by participants.

16.6.2.3 Tools. The exploration of specific tools to use to help facilitate interactions has also received considerable attention in the literature. Miller and Corley (2001) explored the effect of e-mail messages on student participation in an asynchronous online course. The 8-week course had 62 participants, most of whom identified that they had limited prior computer experience. Participation was measured by the number of minutes a student spent in an individual module in the course. An activity report was generated every 5 days to indicate the amount of time each student spent engaged in course activities. Depending on the amount of time (none to significant), a coded e-mail message was sent to each student following the generation of the activity report. If there was no activity, a negatively worded message was sent to the student. If there was significant activity, a positively worded message was sent to the student.

Results indicated that the negative messages resulted in increased activity by the student. The positive messages resulted in no change, or in some instances, a decrease in effort. As indicated by Miller and Corley (2001), e-mail messages seemed to increase the motivation of the students who were not progressing at a satisfactory level. While the positive messages did not have a positive impact, the researchers were careful to point out this did not indicate that positive messages should not be sent. Rather, Miller and Corley suggested that the students appear to be sufficiently self-regulated and may not require as much feedback.

16.6.3 Opportunities and Challenges Associated with Intentional Community Building

Community building has received considerable attention in the literature at the turn of the new century. Rheingold (1993) provided the seminal work on online communities in *The Virtual Community*. Rheingold discusses the Internet's first large, thriving community (*The Well*), grassroots organization and activism online, MUDs, and individual identity online. More recently, Palloff and Pratt (1999) discuss building communities in online environments. The authors describe both the opportunities and challenges associated with the creation of community in Web-based learning contexts.

Earlier research in the area of community building focused on Internet-based technologies. Parson (1997) documented the use of electronic mail for the creation of community in an online learning context. According to Parson, the use of e-mail served to draw students together, enabling the formation of a community where information could be shared and everyone could learn from one another.

Many other researchers followed in the path of such early pioneers as Rheingold, Parson, and Palloff, and Pratt, examining a variety of issues associated with community building. For example, Weedman (1999) explored the capabilities of

electronic conferences for facilitating peer interactions. Weedman's research indicates that the conference environment was effective for the extension of the educational community and that posters to the conference noticed the impact significantly more than lurkers on the forum. Wiley and Edwards (2002) have also conducted research in this area, exploring self-organizing behavior in very large web boards. Wiley and Edwards concluded that very valuable informal learning occurred even in these informal, ill-structured environments.

Moller, Harvey, Downs, and Godshalk (2000) explored the impact of the strength of the community on learning achievement, studying 12 graduate students in an asynchronous course. The primary means of interaction and community building for the students occurred through an Internet-based conferencing tool. Results from the study indicated a relationship between learning achievement and strength of the community. While not conclusive, this study would seem to indicate that spending time on community-building activities would be valuable in an Internet-based interaction.

The study of the impact of community on learning is not a new construct. Wegerif (1998) studied the impact of community in an asynchronous context. He specifically conducted an ethnographic study of how social factors impact learning. Results indicated that participants felt their learning was a part of the process of becoming a part of a community of practice. More specifically, the participants reported that a supportive learning environment greatly facilitated their learning.

Murphy and Collins (1997) also found that a supportive learning environment is important for learning in their research. Participants in their study indicated that it was important to know other learners in the course. Participants stated this enabled them to establish trust, and provide support to each other. Knowing each other, trust, and support (among other things) enabled the creation of a safe and secure learning environment, a factor other researchers have indicated as important for interactions in online environments (Hill, 2002).

Hill along with her colleagues Raven and Han (2002) have proposed a research-based model for community building in higher education contexts. This work is an extension of Hill's (2001) earlier work in community building in online contexts. In the model, Hill et al. (in press) propose that attention must be given to a variety of issues if community is to be enabled within a Web-based learning environment. While the model has not yet been tested, it holds considerable promise for the creation of presence within a virtual context.

16.6.3.1 Building Community in Informal Learning Environments.

Wiley and Edwards (2002) reviewed informal learning in large-scale web board environments and found strong similarities between the group processes employed there and those described in Nelson's Collaborative Problem Solving process (Nelson, 1999). Wiley and Edwards explained the communities' ability to engage in these activities without central leadership in terms of biological self-organization. Stigmergy, "the influence on behavior of the persisting environmental effects of previous behavior," allows social insects to communicate with each other indirectly by operating on their

environment (Holland & Melhuish, 2002, p. 173). Web boards provide individuals the same opportunity to operate on the environment, leaving traces that will spur others onto further action.

Kasper (2002) explored open source software communities from a communities of practice perspective. An open source software community consists of a group of geographically dispersed individuals working together to create a piece of software. Each community is distinct, and the cultural expectations in terms of interaction patterns, programming style, and other conventions can take a significant investment to master. Kasper found that the significant learning necessary for individuals to become productive members of the group frequently occurs without formal instruction, conforming to Lave and Wenger's model of legitimate peripheral participation (Lave & Wenger, 1990). Netscape's open source browser project Mozilla (<http://www.mozilla.org/>) provides an excellent example of the type of support necessary for movement from the periphery into the core of an open source community.

While the social component of informal learning is significant, there is also considerable informal learning that occurs on an individual basis. To date, this area has not been widely explored via research outside of museum settings (Falk & Dierkins, 2000; Hein, 1998). More research is needed in other contexts to extend our understanding of how and why the Internet is used for learning outside of formal contexts.

16.6.3.2 Continuing the Dialogue. A need for interactivity and making connections continue to be two appealing aspects of Internet-based learning. The increased proliferation of Web-based courses along with the growth in use of technologies like chat rooms, bulletin boards, and virtual classrooms that enable two-way audio and video, are indicators that the interest in Internet-based learning has grown beyond enabling the retrieval of content online. Indeed, the focus has increasingly shifted to exploring ways to assist learners in communicating with other learners and teachers and other experts, and for teachers to communicate with teachers, administrators and, in some instances, parents.

While the opportunities are considerable and the appeal continues to grow, much work remains in the area of *learning through* the Internet. The infrastructure—both in terms of hardware and software—is a challenge. The physical network of the Internet can only support so much activity. Limited bandwidth is a significant barrier to robust, sustained use of the Internet for learning. The software currently available is also problematic. Exploration of how to increase throughput, along with how to make the interface into this promising world of learning, is greatly needed.

We are also faced with much more daunting question: what is the value-add from Internet-based learning? As we have reported in section three of this chapter, the research is mixed and inconclusive. In a recent broadcast on National Public Radio exploring the benefits of an online law degree program, a primary benefit cited was convenience. In our own informal research with our students, convenience was often mentioned as a key

benefit to Internet-based learning. But is convenience enough? Does it justify the costs—tangible and intangible—associated with Internet-based learning? Until we have completed more research related to the value that Internet-based learning affords, this may be the best answer we have.

16.7 EMERGING ISSUES AND CONSIDERATIONS FOR FUTURE RESEARCH

The Internet is wide open for research and investigation. Research is needed at micro and macro levels, and across learning contexts. Continuing research related to Internet technologies will enable the continued expansion and growth of online environments for learning.

The Internet has demonstrated its capability as an information technology. Its success in this realm is abundantly clear across all sectors of our culture. Internet technologies also offer significant promise as tools for learning. As the Internet continues to grow in popularity as a means for delivering instruction at a distance—formally and informally—the need for research also expands. In the late 1980s, Kaye (1987) suggested a need for research examining how best to use the Internet to facilitate cooperative learning, discovery learning, and development of problem-solving skills and critical thinking skills. In the early 1990s, Schrum (1992) also put forth several questions for research consideration, including:

- In what ways do educators who learn in this manner [using the Internet] integrate the technology into their professional work?
- What is the nature of communication and interaction online and in what ways is it similar or different from other communications? (p. 50)

These are areas that continue to be, and need to be, investigated today. In addition to the broader issues associated with Internet-based learning, there are more specific areas that are in need of further investigation. We have divided these into three main areas—theoretical frameworks, issues related to practice, and ethical considerations. Each of the areas is explored in the following sections.

16.7.1 Theoretical Frameworks

Each of the areas described in the chapter could be built upon and extended as we continue to refine our theoretical understanding of learning and the Internet. However, as stated by Merisotis (1999), “. . . there is a vital need to develop a more integrated, coherent, and systematic program of research based on theory” (p. 50). Clearly there are researchers and theorists seeking to describe a theory related to distance learning, including the use of the Internet for learning. What is needed is a more comprehensive perspective to guide future work: what is needed to move the field toward a more comprehensive framework related to the Internet and learning? Until that question is

answered, individual efforts will continue but fail to bring about a constructive progression in understanding.

16.7.2 Issues Related to Practice

16.7.2.1 Exploration of Best Practices. Best practices remain an area in need of systematic investigation. We would like to suggest a variation on a question posed in the report *What's the Difference?* in which Phipps and Merisotis (1999) asked: what is **the best way** to teach students? Like other researchers before us (see, for example, Reigeluth, 1999), we propose that there is not **one** best way, but rather several best ways. A primary challenge for researchers examining learning from and learning with the Internet is to uncover those best practices relative to specific conditions, learning goals, contexts, and learners. Perhaps that leaves us with one fundamental question: What are **the best ways** to teach students within specific contexts and under certain conditions?

16.7.2.2 Expansion of Use and Research Practices. Instructional uses of the Web have ranged from enhancement to full-engagement in Web-based learning environments. Loegering and Edge (2001) described their efforts to enhance their science courses by enabling students access to Web-based exercises. Web-based portfolios have also been used to enhance courses (see, for example, Chen, Liu, Ou, & Lin, 2001). Researchers have explored immersive Web environments, describing experiences within specific courses (Hill et al., 2002; Lawson, 2000) as well as experiences with providing entire degree programs online (see Boettcher, 2002, for a review). Research related to the Web has focused primarily on pedagogical issues (Berge & Mrozowski, 2001). While these efforts hold much promise for the future of the technology, particularly for learning, some researchers contend that, the majority of the educational uses of these tools simply replicate classroom practice (Jonassen, 2002). The use of the tool, as well as the research practices surrounding it, are in need of expansion if it is to reach its potential as a platform for educational innovation (Berge & Mrozowski, 2001; Jonassen, 2002).

16.7.2.3 Formal and Informal Learning Environments. The call for formal instructional environments on the Internet is clear, and a variety of organizations are rushing to design and provide this training. However, a need exists for structured environments supporting the important informal learning described by Brown and Duguid (2000). The success of the design of these environments will be highly dependent on our understanding of the processes underlying informal learning on the Internet. Hence a great deal more research on this topic is needed.

16.7.2.4 Intentional and Incidental Learning. Interest in and exploration of intentional and incidental learning is documented in the research literature; however, the majority of the studies completed to date have been situated in

face-to-face contexts or in electronic environments outside the realm of Internet-based learning (e.g., information seeking). Both of these type of learning—intentional and incidental—need more study if we are to realize their role in and relationship to Internet-based learning.

16.7.3 Ethical Considerations

16.7.3.1 Using the Internet to Support Learning. Research grounded in ethical considerations is needed. Clark and Salomon (1996) encouraged researchers of media use in education to move beyond the how and why a particular medium operates in instruction and learning. Clark and Salomon (1996) point out that there is an historical precedence related to the adoption of technology for learning: “. . . there has been a pattern of adoption by schools in response to external pressures from commercial and community special interests rather than as a result of identified and expressed need” (p. 475). We call for an ethical consideration of promoting the adoption of technology, pointing out that we have not addressed several basic questions: How can media support instructional objectives? What other roles do media play? What role will teachers play with students using computers to guide learning? How can schools, already overburdened by multiple demands, meet the demands created by the new technologies?

16.7.3.2 Research From, With, and Through the Internet. The 1999 formation of the Association of Internet Researchers (AoIR; <http://aoir.org/>) provides evidence of the interdisciplinary recognition that research on the Internet is not the same animal as research in the “real world.” Many of the differences between these two research loci relate to ethical concerns for the protection of research participants. An AoIR ethics committee preliminary report recounts some of the challenges faced by Internet researchers:

- *Greater risk to individual privacy and confidentiality* because of greater accessibility of information about individuals, groups, and their communications—and in ways that would prevent subjects from knowing that their behaviors and communications are being observed and recorded (e.g., in a large-scale analysis of postings and exchanges in a USENET newsgroup archive, in a chatroom, etc.);
- *Greater challenges to researchers* because of greater difficulty in obtaining informed consent;
- *Greater difficulty of ascertaining subjects' identity* because of use of pseudonyms, multiple online identities, etc.
- *Greater difficulty in discerning ethically correct approaches* because of a greater diversity of research venues (private e-mail, chatroom, webpages, etc.)
- *Greater difficulty of discerning ethically correction approaches* because of the global reach of the media involved – i.e., as CMC (and legal) settings. (AoIR, 2002)

In addition to AoIR, a number of organizations and researchers are rethinking the ethics of research, and even the techniques of research, when the Internet is involved (AAAS,

1998; Hine, 2000; Dicks & Mason, 1998; Schrum, 1995; Waern, 2002).

How must our research methods change to reflect the different affordances and opportunities presented by the Internet? How does our obligation to gain informed consent change when people make statements in “public” settings like an open Web board? Are these environments public like a street corner, or do posters to a web board enjoy an expectation of privacy and protection regarding the comments they make there? These and many other questions are open and must be answered before we can fully engage the Internet as a research site.

16.7.4 Continuing the Dialogue

We have taken a rather broad look at research related to various aspects of Internet-based learning. While there are many other issues that can be explored, perhaps the most pressing issue relates to the broader use of technology for learning. Saettler (in press) has done an excellent job of reminding us where we have come from and the relatively little progress we have made with integrating technology into teaching and learning.

Clark and Salomon (1996) offer assistance in recalling why we may not have seen indicators of significant progress with technology in education in our research. The lessons they recall for us in their work apply to thinking about learning from and with the Internet. These lessons include: (1) no medium enhances learning more than any other media, (2) instructional materials and learner motivation are usually enhanced with new technologies, (3) a need to link technology-based research with cognitive science research, and (4) a need to move beyond the how and why a technology operates in teaching and learning. We would add a fifth “lesson”: while traditional notions of “control” may be difficult (if not impossible) to achieve in educational research, research reports must include more information describing the research setting in order to facilitate meaningful comparisons across studies. If we can learn these lessons, we may be able to extend our research efforts with the Internet and Web 10-fold.

16.8 CONCLUSIONS

In a presentation to the National School Board Association’s Technology and Learning Conference (Dallas, 1992), Alan Kay of Apple Computers drew the analogy between the invention and use of the movie camera to the exploration and use of computer technologies in education. In the comparison Kay related that the movie camera was, at first, only used as a stationary recording device. . . . It was not, according to Kay, until D. W. Griffith realized that by moving the camera and using different shots . . . to focus the attention of the audience and to shape the mood and perceptions of the audience that the movie became its own art form . . . (from Riedel, 1994, p. 26)

As of the publication of this chapter a decade later, the Internet remains in the same position as the movie camera

once was—it is primarily a delivery mechanism. However, Internet-based technologies have most certainly reached the phase where Griffith-type interventions are possible. Research related to the Internet has been represented in the literature for over a decade (see, for example, Baym, 1995; Bechar-Israeli, 1995; Schrum, 1992); reports on Internet-based implementations for learning also date back over a decade (see, for example, Cheng, Lehman, & Armstrong, 1991; Davie, 1988; Hill & Hanafin, 1997; Phelps, Wells, Ashworth, & Hahn, 1991; Whitaker, 1995). While some of the research has been critiques in terms of its quality and rigor (Berge & Mrozowski, 2001; Phipps & Meriotis, 1999; Saba, 2000), we do have a foundation and can continue to expand our efforts based on studies from the last 5 to 10 years.

Use of the Internet for learning is an area growing at an exponential rate. K-12 educators to higher education faculty to business and industry trainers are exploring and/or have moved into this arena to reach learners. As educators are exploring and implementing Internet-based learning environments, they are also exploring how to reach their learners. Indeed, the Internet is a technology that has the potential for enabling the creation of learning-centered distance education environments—ones in which students, teachers, and experts are working together in the learning process.

While the exploration of how to reach learners on a psychological level is underway, there is also a movement toward a blended approach to the use of the Internet for teaching and learning. As stated by Mason and Kaye (1990), “. . . the distinctions currently drawn between distance and classroom-based education may become less clear as applications of new technologies become more widespread” (p. 16). Blended approaches will enable a use of a variety of technologies to meet the needs of learners.

In 1995, Dede presented the idea that Internet-based learning has potential for significant expansion, moving from a “traditional” distance learning to a “distributed learning” paradigm. According to Dede, it is the emerging technologies such as the Internet that make this possible:

The innovative kinds of pedagogy empowered by these emerging media, messages, and experiences make possible a transformation of conventional distance education—which replicates traditional classroom teaching across barriers of distance and time—into an alternative instructional paradigm: distributed learning. . . . (p. 4)

We have yet to realize the promise that Dede described in the mid-1990s. The Internet remains on the threshold as learning tools. The promise of the technology is vast; yet, the potential can be lost if steps are not taken to realize the true potential of these information technologies for learning. What remains to be crystallized are the applications in a learning environment. As we continue to implement and examine the use of the Internet in our learning environments, the factors contributing to their successful implementation will become clearer. Taking the next steps toward the creation of active learning environments using the Internet is just a matter of choice; choosing not to take these next steps will leave the technologies like many other

educational technologies before them: great ideas whose true potential was never realized.

Perhaps it is time to reexamine the questions we are posing related to learning from, learning with, and learning through the Internet. Clark and Salomon (1996) close their chapter in the *Handbook on Teaching Research* with the following statement: "This, then, suggests a new class of questions to be asked: not only what technology, for whom, and so forth, but **why this technology now?**" (p. 475). We have an opportunity to take a critical perspective on the technologies that have captured the attention of all sectors in our society. In taking this step we

seize another opportunity: making a difference in teaching and learning

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