This chapter focuses on the pedagogical and technological aspects of interaction in distance education. It reviews a number of types of interaction and suggests areas and approaches to research that will expand our understanding and competence in using new tools, technologies, and techniques.

The rapid growth of social networks like Facebook, both on and off university campuses, together with access to the Internet over portable devices, has more recently confirmed and hastened the expansion of interest to the domain of contextually embedded, self-directed, informal learning (e.g., Jokisalo & Riu 2009; Bransford et al., 2006). Much of the literature relevant to these domains focuses on student-student and student-teacher interaction. However, the mediated context of distance education has compelled distance educators to consider more seriously interactions between students and diverse educational media (in Moore’s 1995 words “the content”). This chapter considers questions concerning the efficacy of equating this student-content interaction in online environments so dominated by social activity.

Another meaning of interaction becomes clear when it is understood in terms of the scientific and technological developments occurring around the Second World War. The emergence of the science of cybernetics (and also of general systems theory) is perhaps the most important of these developments. As defined by its founder, Norbert Wiener (1950), “cybernetics” is “the study of messages as a means of controlling machinery and society, the development of computing machines and other such automata [and it includes correlative] reflections upon psychology and the nervous system …” (p. 23).

Communication, as Wiener (1950) defines it, is a matter of an exchange of messages “between man and machines, between machines and man, and between machine and machine,” in which the human or mechanical nature of the source or receiver is irrelevant:

When I give an order to a machine, the situation is not essentially different from that which arises when I give an order to a person. In other words, as far as my consciousness goes I am aware of the order that has gone out and of the signal of
compliance that has come back. To me, personally, the fact that the signal in its intermediate stages has gone through a machine rather than through a person is irrelevant and does not in any case greatly change my relation to the signal. Thus the theory of control in engineering, whether human animal or mechanical, is a chapter in the theory of messages. (Wiener, 1950, p. 25)

Such an understanding of communication and interaction, as Packer and Jordan (2000) explain, has “provided the conceptual basis for human-computer interactivity” and is “de rigeur for anyone investigating the psychological and socio-cultural implications of human-machine interaction” (p. xvii). It is largely in this systematic and cybernetic form that the term “interaction” has been integrated into the discourses of distance education, lifelong learning, educational technology, and other educational sub-domains: “Much of learning theory and instructional systems design is founded in or explained by analogous reference to concepts borrowed from General Systems Theory” (Larsen, 1985, p. 17). Moore’s (1989) seminal article describes three forms of interaction in distance education: between students and teacher, among students themselves, and between students and content. Given the elegant simplicity and broad relevancy of these forms of interaction, they are used to structure much of the remainder of this article. Two additional permutations of Moore’s interactive forms, focusing on the teaching role—teacher-teacher and teacher-content interaction—are also considered here. Before we discuss interactive forms derived from Moore, we look at a small number of types of interaction appearing in the literature that fall outside of Moore’s framework.

Hillman, Willis, and Gunawardena (1994) describe a type of interaction they call “learner/interface interaction”—defined as the “process of manipulating tools to accomplish a task” (p. 34). Learner/interface interaction focuses on the access, skills, and attitudes necessary for successful technologically-mediated learning. These authors regard learner-interface interaction as distinct from but not unrelated to Moore’s three types of interaction. Hillman et al. note that “it is important to make the distinction between the perception of interface as an independent fourth mode of interaction, and the use of the interface as a mediating element in all interaction” (p. 34 emphasis added). All forms of interaction in a distance education context are, by definition, technologically-mediated forms of interaction. Thus, Hillman et al.’s interface interaction need not be viewed as a unique form of interaction, but rather as a component of each of the other forms of interaction. One could also argue that even face-to-face interaction is mediated as well—usually with the “medium” being the classroom and institution in which instruction takes place (e.g., see McLuhan, McLuhan, & Hutchon, 1977). For these reasons, we choose not to focus on learner-interface interaction as a separate form of interaction, but do not deny that acquisition of the communication and technical skills associated with it is an integral part of the “hidden curriculum of distance education” (Anderson, 2002).

Building on insights from Fulford and Zhang (1993) and Kruh and Murphy (1990), Sutton (2000) postulates yet another form of interaction termed “vicarious interaction.” In distance education, as in classroom-based learning, not all students interact directly with one another or with the teacher during individual classes or even over the duration of an entire course. However, they may interact vicariously. Sutton defines vicarious interaction as occurring “when a student actively processes both sides of a direct interaction between two other students or between another student and the instructor” (p. 4). In a study based on televised courses, Fulford and Zhang (1993) found that student’s
perceptions of *opportunities* for interaction, rather than *actual* interaction or participation, correlated in important ways with satisfaction with courses. They argue that it is the perception of the opportunity for interaction, rather than actual engagement in it, that results in student satisfaction. Sutton (2000) found that students who interacted vicariously had read, appreciated, and learned from the interactions of others, but they felt no desire to interact themselves and perceived that such interaction would have added little to the course of study. In a more recent study, Mabrito (2007) reported similar findings. However, Kawachi (2003) found no evidence the vicarious interaction leads to improved learning, as did another study by Rovai and Barnum (2003) examining *perceptions* of learning. Without using the term “vicarious learning,” and focusing on online learning, Rovai and Barnum noted that “Only active interaction, operationalized by the number of messages posted by students per week, was a significant predictor of perceived learning” (p. 57). And Beaudoin (2002) has noted that although low-visibility students spent significant time in online learning-related tasks, “high-visibility learners” (p. 147), those that interacted, attained higher course grades. Noting such research, our position is that vicarious interaction, because it occurs in combination with other forms of interaction and requires the active interaction of other players to be realized, is not an adequately distinct form of interaction to be viewed as sufficient unto itself.

Interactions between and among students and teachers and their families, workplaces, and communities dramatically influence the context in which formal education takes place. Burnham and Walden (1997) describe this as a fifth form of interaction labeled “learner-environment” interaction (but they associate the word “environment” with a different meaning than Dewey, above). These external interactions are conditioned by broader societal norms and expectations, and are related to a variety of indicators of social status (identified by Burnham & Walden as including gender and race). These larger interactions are complex, sometimes idiosyncratic and generally lie beyond the scope of this paper. However, they cannot be ignored when situating educational interaction in any larger context or community.

In this connection, as Keegan (1980) notes, “In traditional education a teacher teaches. In distance education an institution teaches” (p. 19). Distance students inevitably engage in a variety of institutional interactions in addition to their interactions with the teacher, the content and with each other. They are engaged with registration services, the bookstore, library, help desk, and other services and units. Therefore, learner-institution interaction might be considered a significant type of interaction unto itself (Shin, 2002), and this chapter regards it as such—sometimes referencing it in addition to Moore’s three principle interactive forms.

**STUDENT-TEACHER AND STUDENT-INSTITUTION INTERACTION**

Many of the pedagogical benefits of student-teacher interaction, especially those related to motivation (Wlodkowski, 1985) and feedback (Laurillard, 1997, 2000) can be seen as equally relevant in classroom-based and distance education contexts. Studies of audio (Hampel & Hauck, 2004) and video conferencing (Hearnshaw, 2000; Katz, 2000; Wang, 2004) show that effective student-teacher interaction can take place at a distance, but that the use or absence of these synchronous media, in themselves, has little apparent direct impact on educational outcomes (Russell, 2005). As with related studies of the effects of educational media, the impact of the instructional designs associated with the
use of this media seems to have far greater impact on student achievement than the use of any given medium per se (Clark, 1994). Recent work has looked at student-teacher interaction in text-based, distance contexts (Akyol & Garrison, 2009; Garrison, Anderson, & Archer, 2000; Ke, 201; Moore & Kearsley, 2005; Shea, Pickett & Pelt, 2003). This research confirms the educational value of that student-teacher interaction, even when this interaction is confined to textual communications. Dennen, Darabi, and Smith (2007) demonstrate that student satisfaction is tied to students’ perceptions that their interpersonal communication needs are being met. The three main factors in meeting these needs are (a) instructors’ frequency of contact, (b) their regular presence in class discussions, and (c) expectations being made clear to students. Likewise, Dennen and Wieland (2007) conclude that a consistent, facilitative instructor who anchors discussions around questions and shared artifacts is more likely to produce discourse associated with the co-construction of knowledge.

A major concern for both teachers and administrators is the perception or reality of high workloads and costs associated with student-teacher interaction in distance education. From an administration perspective, Daniel and Marquis (1988) note that the costs associated with interaction between students and teachers “tend to increase in direct proportion to the number of students” (p. 342) in a given class or course. Berge and Muilenburg (2000) report survey results from over 1,000 American distance education teachers that identify concerns with increased time requirements as the largest barrier associated with adoption of networked forms of distance teaching. Is this perception a function of unfamiliarity with media and uncertainties regarding appropriate instructional design, or is it an implicit attribute of technologically-mediated teacher-student interaction? There has now been some research measuring teacher time that does not support the claim that online courses imply an increased work load when compared to their offline counterparts (DiBiase, 2000; Hislop & Ellis, 2004; Lazarus, 2003; Lesh, 2000; McLain, 2005). However, concerns with the high cost of online forms of education continue, and the challenges of measuring and compensating teachers appropriately for time spent in teacher-student interaction remain (Fielden, 2002). Moore’s (2000) advice in this regard is sensible (if not always to be unproblematically implemented): The expenditure of teacher time should not be a question of more or less work than in the classroom, but rather “getting better quality out of the same effort” (p. 5).

Whether online course environments are structured using a learning management system like Blackboard or Moodle, and/or some combination of Web 2.0 tools (e.g., blogs and wikis), communication between teachers and students might occasionally require some other interactive communication mode for reasons of confidentiality or for purposes of problem resolution. As Sheer and Fung (2007) demonstrate, email communication can contribute positively to professor and individual student relationships. And sometimes communication is facilitated through asynchronous mediated conversation through the use of telephones or Skype (O’Leary & Quinlan, Jr., 2007).

Garrison et al.’s (2000) Community of Inquiry (COI) model suggests that an important dimension of student-teacher interaction is the reciprocal perception of “social presence.” Social presence is defined as “the ability of learners to project their personal characteristics into the community of inquiry, thereby presenting themselves as ‘real people’” (Community of Inquiry Model, 2011). For teachers, presence is purposeful and is operationalized in the model as “teaching presence,” which Anderson, Rourke, Garrison, and Archer (2001) define as the “design, facilitation, and direction of cognitive and
social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes.” The result of meaningful teaching presence is expected to be “greater positive affect and higher perceived cognition than [that obtained] by less immediate [or ‘present’] instructors” (Baker, 2004, p. 1).

Given the recent rise in the use of social media, and the social nature of Web 2.0 technologies, the emphasis on social presence in the COI model seems prescient. However, with very few exceptions (e.g., Shea et al, 2010), the model has not been applied to social networks and socially oriented Web 2.0 contexts. There appear to be both practical and methodological reasons for this: practically, commercial environments like Facebook or Twitter (whatever their advantages and disadvantages for educational communication) do not provide ready access to a complete set of communication for identification and analysis of patterns of social and teacher presence as do traditional educational systems such as Blackboard. Also, these systems tend to foster a kind of communication that is arguably more germane to processes of leisurely socialization than other forums and technologies specifically designed to foster deliberation and reflection (Friesen, 2010).

### STUDENT-STUDENT INTERACTION

The educational potential of collaborative and cooperative learning was not available to students involved in early, correspondence-based distance education. Work on the social construction of knowledge (Brown & Duguid, 2000; Rogoff, 1990), communities of practice (Wenger, 1998; Wenger, McDermott, & Snyder, 2002), situated learning (Lave, 1988), and the applications of these theories to education have resulted in a rich and growing body of knowledge related to student-student interaction and collaborative learning (Brown, 2001; Johnson, Johnson, & Smith, 1991; Slavin, 1995). Most of this research has focused on classroom contexts, largely with school age children. However, adult students—especially those involved in professional development—have also been shown to benefit from student-student interactions—specifically those interactions associated with a sharing of common professional concerns and aspirations (Brookfield, 1987; Schön, 1991). Damon (1984) observes that “intellectual accomplishments flourish best under conditions of highly motivated discovery, the free exchange of ideas and the reciprocal feedback between mutually respected individuals” (p. 340).

Marshall McLuhan famously observed that “the ‘content’ of any medium is always another medium,” usually the medium that came before it (1964, p. 8). This observation can be adapted to collaborative learning in distance education: forms of collaboration originally fostered online were transplanted from conventional educational settings (e.g., “discussions” or “office hours”). Only more recently have distance educators sought to facilitate forms of student-student interaction which are not possible in conventional classroom contexts. Although it is not unambiguously substantiated in research (e.g., Hopkins, Gibson, Solé, Savvides, & Starkey 2008), researchers and practitioners alike believe that interaction between students is a precondition necessary for deep learning. John Dewey anticipated and influenced social constructivist theorists when he described the ideal student’s engagement with his or her subject matter as follows: “getting outside of it, seeing it as another would see it, considering what points of contact it has with the life of another so that it may be got into such form that he can appreciate its meaning” (Dewey, 1916).
Collaboration between learners or students taking place on computer networks is far from being a new phenomenon. There have been practitioners and advocates of collaborative learning for classroom groups prior to the advent of distance education on the Internet. Smith and MacGregor (1998) define collaborative learning as an umbrella term for educational approaches that involve joint intellectual effort by students, or students working together with teachers. Typical collaborative learning situations involve students working in groups of two or more, together seeking understanding, solutions, meanings, or creating a joint intellectual product, such as an essay, report, or Web resource.

Collaborative learning is associated with a number of beliefs and assumptions, for example: that learning is an active process of creation; that it depends upon rich contexts; that it is inherently social; that it has both affective and subjective dimensions; and that individual students each bring with them diverse skills and experiences that are, together, mutually reinforcing (Smith & MacGregor, 1998). Kennedy and Duffy (2004) contextualize these assumptions for successful online collaborative learning: students must be prepared for such learning by course providers; technical support is essential, especially at the start; teachers must be proficient in supporting this learning; and the institutions themselves must openly support it. Finally, since collaborative learning requires investment of student time and effort, inducements or incentives should be integrated with it. It is widely observed that collaborative learning must be made integral to courses through effective and compelling design and facilitation, otherwise students will simply spend their time on individualized work.

Peer interaction is a critical component of the formal curriculum in many disciplines. The capacity to work together effectively in teams and within professional communities and to communicate effectively with colleagues and clients, is generally regarded as critical to both vocational and personal success. Indeed, many forms of learning can be defined as the process of becoming a member of a community of practice and as requiring the internalization of the methods, language and culture of that community. As Brown and Duguid (2000) assert: “Become a member of a community, engage in its practices, and you can acquire and make use of its knowledge and information. Remain an outsider, and these will remain indigestible” (p. 126). Wenger et al.’s (2002) definition of communities in this regard is useful: A community of practice, they say, is constituted by “groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their understanding and knowledge of this area by interacting on an ongoing basis” (p. 4). Online professional programs, such as masters programs in business, education, nursing, engineering, and computer science can benefit from being deliberately designed to encourage the formation of such communities of practice, with students adopting and developing the vocabulary, discourse and values of working practitioners.

Moller (1998) proposes that encouraging the formation of community in distance learning contexts has two functions: (a) social reinforcement, through shared identity based on shared values, norms and preferences, resulting in more group cohesion and less attrition, and (b) information exchange, through collaboration and knowledge building. Swan et al (2000) emphasize three factors that contribute to the success of online courses organized to support “knowledge building communities: “[1] a transparent interface, [2] an instructor who interacts frequently and constructively with students, and [3] a valued and dynamic discussion” (p. 379). Rovai (2002) finds that
online students who develop a strong sense of community and perform well also feel less isolated and have greater satisfaction with their academic programs. McInerney and Roberts (2004) propose three protocols that can be built into online courses to foster a sense of community and productive social interaction: (a) greater use of synchronous communication; (b) inclusion of a community “forming” stage, or warm-up period; and (c) the use of guidelines for successful online communication.

Despite the many pedagogical benefits of interaction among students, some students have been shown to purposely select distance education formats that support independent study, free from the temporal restraints and also interpersonal contact associated with collaborative forms of learning (Daniel & Marquis, 1988; Pagney, 1988). Arnold (1999) argues that by deliberately targeting such student preferences, distance education can “be closer to the content of the learning process and closer to the comprehension and grasp of the problems by individual learners” (p. 5). It is clear that we can no longer assume that distance education is, by definition, either a purely individualized or an entirely collaborative process. When we seek to encourage student-student interaction in distance education programming, we should ensure that instructional designs follow validated best practices, to promote interactions that justify the restrictions that they may impose on student’s temporal independence.

In addition to the debate between those who advocate independent forms of distance education and those in favor of explicitly collaborative approaches (e.g., Garrison, 1999), still others argue for the functional equivalency of the three principal modalities of interaction: student-student, student-teacher and student-content. This position has been articulated in conjunction with what Anderson (2003) refers to as the “equivalency theorem” (see also Miyazoe & Anderson, 2010). This theorem consists of the claim that student interactions with teachers, with other students or with content are all ultimately equivalent in terms of their educational efficacy; that “deep and meaningful formal learning is supported as long as one of the[se] three forms of interaction … [occurs] at a high level” (Anderson, 2003, n.p.). A number of studies, including a meta-analysis of existing research (Bernard et al. 2009), shed light on this claim of interactional equivalency. These studies show that all three kinds of interaction are indeed perceived as valuable by students (Rhode, 2009). They also suggest that the importance of the three types of ITs (i.e., those used in the three types of interaction) is found to be associated with increasing achievement outcomes (Bernard et al., 2009). However, these findings do not go so far as to support the notion that student-student, student-teacher and student-content interaction are equivalent and thus functionally interchangeable. In addition, the literature has yet to show that the use of the term “theorem”—as a “universal” and “demonstrable … proposition or statement” (per the Oxford English Dictionary)—is justified in conjunction with educational interaction in wide and varied fields of educational practice.

In addition to research focusing on collaborative learning and learning in online communities in general, there are numerous studies on various aspects of interactions occurring specifically between students. Indeed, the category of student-student interaction appears to have been investigated far more than the other types of educational interaction discussed here, with many researchers making fine-grained distinctions between types and phases of social interaction between students. For example, Lobel, Neubauer, and Swedburg (2002) hypothesize four distinct stages of interaction in online courses: (a) greeting, (b) gathering, (c) activity, and (d) conclusion. Furthermore, each
activity stage also has four distinct phases: (a) adding knowledge to the group, (b) facilitation, (c) building on the knowledge of others, and (d) reporting back to the group. This kind of detailed theoretical understanding can aid in the instructional design support for learning interaction activities. Molinari (2004) emphasizes the role that social communication plays in online group problem-solving courses, where students employed elements she refers to as self-revelation, “tying,” and etiquette to construct a foundation for collaborative work. The implication is that instructors need to provide time and space for broader socializing as an enabler of communications with a more specific educational focus. And Merrill and Gilbert (2008) conclude that for problem-based learning superior learning outcomes can be obtained when all phases of the problem-solving exercise are structured around peer interactions. Finally, Garrison and Cleveland-Innes (2005) argue that interaction among students “is not enough” and that teaching presence is necessary to provide “the structure (design) and leadership (facilitation/direction) to establish social and cognitive presence (i.e., community of inquiry)” (p. 144).

No current consideration of interaction among students would be complete without mention of social networking services, particularly Facebook. Indeed, it seems difficult to underestimate the significance and potential of Facebook in educational terms generally: fully half of its users self-identify as students, and half of Facebook users again identify themselves as being between the ages of 18 and 24 (Istrategylabs, 2009). In fact, one study indicates that these users “generally believe that Facebook is intentionally for college students” (Jaschik, 2009), perhaps because it was originally designed as such. From the perspectives of marketing, support and pedagogy, Facebook and services like it represent environments for which students have voluntarily self-selected, in which they have further segregated themselves according to location, institution, etc., and in which they are intrinsically motivated to participate. Educators have advocated ‘integrating Facebook, Ning, and other sites into K-12 [academic] life’ (Davis 2010; see also Muñoz & Towner 2009). Advocates have promoted their use as part of a “connectivist” learning theory (Siemens, 2006), which elevates social and communicative interactions and connections to the level of an epistemic category seen as central to learning. This type of learning is characterized not only by greater autonomy for the student, but also by changing roles for the teacher; indeed, a collapse of the distinction between teacher and student altogether (e.g., Couros 2009; Downes, 2005).

It is clear that more research on interaction between students—both on social and explicitly educational platforms—remains to be done. As indicated above, Hopkins et al (2008) assert that the claims made for the potential of student-student interaction, as well as interaction with teachers, to promote higher-order critical inquiry and the social construction of knowledge, require further investigation and evidentiary support.

**Student-Content Interaction**

Despite the attention that Facebook or other social media have directed towards social interactions between students, interaction with educational content remains central in distance education. In traditional distance education, this has meant study with texts and other media, often supplemented by faculty-created study guides.

Interaction with content in educational contexts can take many forms and serve a variety of functions. Sims (1997) reviews taxonomies of student-media interactions and proposes a “developers classification” that includes object; linear; support; update; construct; reflective; simulation; hyperlinked; immersive; and non-immersive virtual forms
of interactivity. In a study of the benefits of interactivity within an educational Website, Brady (2004) finds that student-content interactivity positively influenced learning outcomes, satisfaction, and student time-on-task. Tuovinen (2000) classifies these media into five basic categories—sound, text, graphics, video and virtual reality—and pays particular attention to combinations that include sound with any of the other media. He argues that sound and visual images are processed by different parts of the brain and thus combinations of sound with other media are less likely to produce cognitive overload than other combinations. Tuovinen (2000) also adds “multimedia creation” as a separate, more constructive form of student-content interactivity. Benefits of this explicitly creative form of interaction are associated with learning acquired through development of the structure, strategies, and skills needed for effective content creation (Dunlop, 1999).

Clark (2000) has suggested that any evaluation of student-content interaction must recognize that every distance education context consists of two distinct levels of interaction—the first dealing with attributes of the media that support the interaction, and the second with the instructional or learning design. The temptation to confound these two separate types of student-content interaction, according to Clark, is at the root of many of the terminological and research problems debated in the literature. Although it is conceptually useful to differentiate and even measure these interactions as distinct events, Marshall McLuhan’s (1964) famous aphorism that the “the medium is the message” reminds us that the isolated analysis of such events fails to address larger issues related to educational media and their significance. The significance—the message of any instructional medium—often has much more to do with the instructional strategy in which the medium is used, than with the learning outcomes it supports. For example, Diaz (2000) makes a convincing argument that research designs informed by an “instructivist worldview” are not likely to be useful for student-centered and constructivist forms of learning. Research methods that illuminate differences within applications of particular sets of instructional designs are likely to be more productive than those that are designed to compare the effect of interactions across different media and instructional designs.

Myriad Web-based technologies and services like blogs, wikis, YouTube, and Google have been significantly altering the context of student-content interaction. In combination with these technologies and services, work on the development and promotion of Open Educational Resources of various kinds (e.g., Friesen, 2009; Hylén, 2007; Yuan, MacNeill, & Kraan, 2008) provides educators and students with an expanded set of student-content interaction resources. The pioneering work of the MERLOT consortium (http://www.merlot.org) and more recent efforts by open resource and courseware consortia (http://www.oercommons.org; http://www.ocwconsortium.org) have expanded possibilities still further. These projects have created new potential in these areas in large part by making course contents and other educational resources available with few or no legal restrictions on use, reuse, and adaptation. The initial exuberance over the potential of reusable open educational resources (and before them, learning objects) has been tempered by realization that learning or rather, education, is locally and culturally contextualized (Friesen, 2007) and that any one resource’s efficacy is dependent upon its use in contexts such as effective learning designs (Koper, 2001). Further, the challenges of opening teachers’ practices, and increasing their awareness of the possibilities presented by openly sharing educational resources and courseware have been identified.
as a significant handicap for the open educational resource community (e.g., D’Antoni, 2008). Nonetheless, it is becoming increasingly easy to find activities and tools designed to enhance student-content interaction, gathered together in various collections on the Web.

There are, of course, many illustrations of the use and development of interactive content—some quite innovative and instructive. For example, Theroux and Kilbane (2004) describe an innovative use of a real-time business case distributed via the Internet to business classes at four universities in the United States and Canada in 2001. A case writer, stationed full-time at a given company, published weekly case installments on the Internet, allowing students to view real-time corporate operational data in depth and detail. In addition, students shared their analyses and thinking with company management, influencing the corporate decision-making process. The Internet also enables such student interaction with dynamic real-world content.

A variety of relatively new network services allow students to direct and in some cases, automate aspects of their interaction with content. Among the technologies used are various forms of syndication (RSS, podcasts, etc.). Syndication provides real-time notifications (in machine readable format) of new additions to a Web-enabled resource or collection such as those maintained by a publishing house, generated in a discussion group, or the postings of an individual blogger. These syndicated notices can be searched, sorted, and aggregated by individuals or groups of students or teachers to create customized and personal views of emerging content. A variation on this type of syndication is offered by Twitter, which allows status updates (or “tweets”) of a maximum of 140 characters in length to be generated by any one user and also aggregated with any number of other users’ tweets. Updates can be collected asynchronously or in real time, and the practical gains that are realized from this new technology range from the effective coordination of scattered protest groups through to the emergence of audiences for the updates of celebrities and academics alike. A broadly comparable set of functions is provided by Facebook’s “News Feed,” the listing of photo, video, and textual updates and responses that appears as one’s homepage on the service. As this Facebook example shows, such a regularly updated selection of contents and contributions is by no means restricted to text-based media—much less messages shorter than 140 characters.

Content may also be designed for very specific instructional purposes, to interact with students at various levels of sophistication. The goal of these adaptive content systems is to customize interaction for individual student needs, including the:

... ability to set the level of the lesson closely to the student’s current and changing level of understanding, to alter instructional strategies and provide remedial tutoring as required, to respond to student input at various levels from keystroke to the overall plan of the solution to the problem, and finally to detect and analyze mistakes in terms of conceptual errors. (Eklund, 1995)

Research determining how content is and can be programmed to interact with the attributes of individual students or users is the subject of much human–computer interaction study (Graff, Lin, Kinshuk, & McGreal, 2011) and also some controversy.

In his book *The Filter Bubble* (2011), Eli Pariser focuses at length on how services like Facebook, Google, and Yahoo use sophisticated and hidden algorithms to customize content (e.g., feeds items, search results, and advertising) according to users’ past
behaviors and current inputs. Pariser argues that these mechanisms can lead to a kind of “information determinism,” a situation in which our past queries, selections and even evasions may “entirely decide” what is made available for selection and interaction in “our future” (p. 90). In his examination, Pariser offers some distinctions and cautions that are relevant in considering the potential (and limitations) of adaptive content in distance education as well. For example, Pariser’s discussion makes it clear that there are two kinds of customization that can be offered by this type of content: The kind in which the user is aware of customization and able to control it (e.g., through a profile or by selecting parameters through an online form), and the type that is set automatically and invisibly through his or her past behavior. Significantly for educational concerns, Pariser makes the case that this second type of customization or filtering may limit the user’s “autonomy.” “To be free, you have to be able not only to do what you want, but to know what’s possible to do” (2011, p. 74). By definition, content that has been adapted, filtered, and personalized based on an individual’s previous activities has excluded some possibilities for action. And given that one of the higher aspirations of education has long been personal autonomy (e.g., Biesta, 2002; Kant, 1784), and that the issue of learner autonomy is a constant feature in distance education (Bouchard & Kalman, 1998), this discrepancy will likely continue to pose challenges for educators, developers and researchers.

At the same time, a related and recent development that has attracted significant interest, and that has potential relevance for student-content interaction is represented by research in academic and learning analytics. This refers to “the statistical evaluation of rich data sources to discern patterns that can help individuals at companies, educational institutions, or governments make more informed decisions” (Educause, 2010). Analytic information concerning learning and study patterns, it should be added, can also help individual students, teachers and instructional designers also make informed decisions about their own academic teaching and design activities and strategies. This data or information can be provided to support either of the types of customization suggested by Pariser—whether student-controlled or purely algorithmic. In each case, the rich data sources from which academic and learning patterns can be discerned can have quite conventional sources. These include in particular the learning and content management systems that have long been in place in many university and college contexts, and the records they automatically generate of student activity.

This type of research and development is seeking to provide ways in which users’ interactions with various systems can be defined, interrelated, analyzed and understood in terms of typical patterns and profiles. Thus, certain patterns of use (or of non-use) of an online system by one user might fit the profile established by earlier non-completing students, or alternatively, by students who were able to challenge the course before its conclusion. In keeping with the ambitions of student-content interaction, this might result in an automated email and/or text message being sent to the student, as appropriate to his or her situation (e.g., Educause, 2010). Others (e.g., Duval, 2011) have envisioned teachers and students alike being provided with a type of “dashboard” showing “visual overview of their activities and how they relate to those of their peers or other actors in the learning experience” (n.p.). In this way, as Duval and his co-developers claim, students and teachers would no longer be asked to “drive blind” in the context of online educational experiences.

However, it is obvious that the application of academic analytics does not need to
conform to the logic of student interaction purely with content, but may involve forms of student-institution or student-teacher interaction as well. It may be more effective to send an alert for teacher intervention based on patterns indicative of student non-completion or of early completion in a course currently being delivered. It is also important to note that unlike some visions of content personalization or adaptation, the goals generally articulated in conjunction with analytics are to increase student self-awareness and options for self-determination based on information related to previous performance, rather than to “filter out options in advance.

A final comment on student-content interaction relates to the recent phenomenal growth in interest and use of content formatted as educational games or simulations. Of particular interest are (massively) multiplayer interactive games, in which remote players interact simultaneously in three-dimensional environments; these present obvious potential for both student-content and student-student interactions in distance education. The interest of educational researchers in this area has typically been justified not so much in terms of the content of popular game titles, but by pointing to the structure and scale of these games and the industry producing them:

Much attention has been directed to the use of video games for learning in recent years, in part due to the staggering amounts of capital spent on games in the entertainment industry, but also because of their ability to captivate player attention and hold it for lengthy periods of time as players learn to master game complexities and accomplish objectives. (Dondlinger, 2007, p. 21)

While these two factors are still very much a reality in interactive games, the educational expectations to which they have given rise remain largely unfulfilled. Some, like Klopfer, Osterweil, and Salen (2009) attribute this to “high development costs” for sophisticated games, and a range of other economic and cultural factors, such as the highly competitive game market and “fickle” player “loyalty” (p. 19). At the same time, as these and other authors suggest, there may be deeper structural reasons for the lack of success in educational gaming: namely that what makes games fun is not necessarily compatible with the sometimes less than pleasurable arrangements in education: “Effective use of games and other new technologies” as Klopfer et al. observe, “is likely to be limited unless educational institutions are willing to consider significant changes in pedagogy and content, and rethink the role of teachers and other educational professionals” (p. 19; see also Stutt, 2010). A rethinking of this kind is no small task, and it points in a direction quite different from that of the original enthusiasm concerning the compatibility of computer games with the central educational values of captivating and constructively directing effort and attention. As a result, it remains to be seen the degree to which the perceived potential of this form of student-content interaction will be realized.

**Teacher-Content Interaction**

A form of interaction that this chapter considers in addition to the three originally identified by Moore is interaction between teachers and content. As indicated above, the selection, development, and application of open educational resources is likely to become an increasingly important component of the teacher’s role in both distance and classroom-based education. In keeping with teacher abilities, and the legal restrictions and possibilities associated with a given resource, it may be possible to customize and
adapt it to specific pedagogical requirements. This adaptation may happen through relatively sophisticated means, for example, by setting the external parameters for Flash® or other software-driven resources. Or it may happen in more humble ways through revision of a wiki page, or of an online document on a word processor or via a service like Google Docs. Since some alternative licenses allow or even require resources, thus modified, to be redistributed, this type of activity is in some cases likely to foster even further teacher-content interaction. It may involve even further instructional personnel in the development, improvement and varying adaptation of a given item. A simple example of this is provided by the translation of MIT open courseware into Mandarin (e.g., Lee, Lin, & Bonk, 2007), one of the principle forms of reuse of this particular content offering; another is provided by the composition, use, and adaptation of wiki resources in WikiEducator and Wikiversity (e.g., see Friesen & Hopkins, 2008). Other examples are covered in a number of recent overviews (e.g., Morgan & Carey, 2009).

Still other tools and environments, from composition and presentation services (e.g., Slideshare.net; Prezi.com) to complex authoring environments, allow teachers to be more active in content creation than in earlier eras when instructional designers and programmers performed much of this work. For example, lectures, student discussions, and debates are easily captured and digitized to create iPod and video-casts that are retrievable by students. Although some have argued for the pedagogical and administrative superiority of content produced by teams of experts, as opposed to “Lone Rangers” or independent teacher-designers (Bates, 1995), the recent explosion of largely instructor-created content, produced with the aid of authoring and delivery systems such as Mediawiki, Moodle, and Blackboard®, illustrates that teachers can (either alone, or with minimal consultative assistance) produce workable curricular content.

One advantage of such homegrown content that is often overlooked is that it can be continually updated and annotated while being put to use. This allows the instructional design processes to continue throughout the delivery timeframe unlike various forms of canned instruction (Tuovinen, 2000). Finally, we can expect these authoring and distribution systems to become more comprehensive, functional and user friendly, as they evolve in both commercial and open source development models. Where more work is needed is in the development of more sophisticated pedagogical tools for the creative interaction of teachers with educational content. Tools are needed that assist teachers in designing and supporting courses based on a variety of pedagogical theories and offering a diversity of customizable learning activities.

Current tools too often limit our perception of the technological affordances of distance education to threaded discussions, provision of hyperlinks, and textual content. It is discouraging to note the lack of pedagogical innovation in many of the allegedly sophisticated content development and delivery tools currently available. For example, the type of threaded discussion forums employed in course delivery today, via platforms such as Moodle and Blackboard, show little pedagogical advance over the conferencing tools used on mainframe systems some 30 years ago (Hamilton & Feenberg, 2005). The hope is that the combination of the example of convenient Web 2.0 and social networking features combined with pedagogically driven innovation may create opportunities for more significant interaction between teacher and content (and between other interactive elements as well). The development of more sophisticated, powerful, and cost-effective systems that can be customized by teachers to enhance interaction in all its forms would be of great value to distance education (Trafford, 2005).
In summary, collections, resources, and tools enabling teacher-content interaction, along with new licensing options, have been proliferating, allowing smaller-scale distance education efforts to continue to flourish. Teachers using these tools are increasingly able to create powerful distance learning programming that supports high levels of interaction of many different qualities and modalities.

Despite some cause for cautious optimism concerning teacher-content interaction, it is clear that concerns of administration and management must be addressed that take into account both the cost and benefit of teachers’ creative interaction with content. The major issues to be addressed in connection with teacher-content interaction will continue to be workload, changing skill sets, copyright, and the sometimes contentious relationship between teaching and research, especially in university contexts (Brand, 2000).

**Teacher-Teacher Interaction**

Internet and Web technologies are providing unprecedented opportunities for various forms of interaction between teachers. Interactive, online forms of social and professional networking are increasingly being leveraged by teachers to stay abreast of developments in both their own disciplines and in distance teaching pedagogy. This interaction between teachers forms the basis of networked scholarly communities of practice within formal education institutions, as well as scholarly societies, or invisible colleges (Genoni, Merrick, & Willson, 2005; Wellman, Koku, & Hunsinger, 2005). Kahnwald (2011) found that the first and most important source of assistance in technical and other challenges comes not from the most informed experts, but from colleagues who are at hand. Koku and Wellman (2004) note that computer-mediated communication provides a technological platform for new kinds of “spatially-based, loosely-bounded, networks of scholars that are more connected than the fitful, amorphous relationships of the past and less physically proximate and bureaucratically structured than contemporary universities” (p. 301). Experience with network-based professional development (Anderson & Mason, 1993; Williams, 1997), as well as active online social networks of scholarly and other professionals (e.g., http://academia.edu; LinkedIn.com) are illustrative of the potential of this form of teacher-teacher interaction.

We have been seeing the emergence of distance and online teaching portals and networks in which resources, tools, and forums for exchange and interchange between teachers are gathered in a single online location. These portals are supported by professional distance education publishers (i.e., http://Distance-Educator.com), commercial educational software vendors (i.e., www.blackboard.com), postsecondary institutions (i.e., http://www.uwex.edu/disted/home.html; http://www.umuc.edu/ide/), and non-profit professional research and development organizations (i.e., http://tappedin.org/tappedin; http://cider.athabascau.ca; http://www.digitallearning.org/about.htm).

**INTERACTION CHOICES**

Interaction in any of the various modes described above may take place either synchronously or asynchronously and be instantiated in text, audio, video, or in combinations of these communication forms. Unfortunately, too many distance educators and institutions have chosen to restrict themselves to one particular technology and instructional design in defining their own current delivery models and instruction. Just as
developments in academic analytics and social networking make it increasingly difficult to separate different forms of interaction (e.g., with content, with others, with the institution), allegiances to one particular technology, design or model are similarly becoming less and less tenable. Teachers and institutions now have the potential to select from a wide variety of forms of mediated interaction. However, such variety creates challenges as educators and administrators are asked, in effect, to make numerous decisions related to the use of media and interactive technologies.

This is made all the more challenging by the lack of unambiguous and useful research results. For example, despite years of study, it is still unclear which students, studying what types of content, under what conditions, and under which instructional design, benefit most from synchronous as opposed to asynchronous interaction. It seems clear that students report positive experiences and achieve learning outcomes using modes of interaction that are either wholly synchronous or asynchronous, as well as both (McInerney & Roberts, 2004). It is also fairly clear that most modes of interaction discussed above are positively associated student satisfaction and other educational goals (e.g., Rhode, 2009; Bernard et al., 2009). It may be that the sheer number of variables in real life situations makes any determination of effective combinations of kinds of interaction (together with kinds of content and designs) impossible. It may also be that expectations, costs (from student, teacher, and institutional perspectives), as well as convenience, may be the most significant determinants of combinations of interactive forms. Allowing these factors to alone determine distance education formats and offerings, however, carries an implicit threat to the critical potential of distance education to enhance access to education, which may be endangered. Damarin (2000) has provided a useful set of five principles for decision making based upon the equitable use of technology in education that are designed to reduce rather than exacerbate the digital divide.

Distance educators have traditionally chosen the most inexpensive and widely available media for delivery and excluded alternatives that limit access by requiring student ownership of costly equipment or high access costs. The attraction that opportunities for social interaction hold out for students has justified this approach. As the popularity of services like Facebook and Twitter attest, students show a remarkable willingness to adapt to the constraints of lean media (O’Sullivan & Hoffner, 1998) in return for opportunities to maintain and develop social relations. However, costs and accessibility of voice and video connectivity (in both synchronous and asynchronous) formats continue to fall as availability continues to rise. We can perhaps expect to see increased use of richer media to support interaction in distance education. The recent and widespread adoption of Skype video, voice and text technology by Internet users may already be ushering in an era of richer student-teacher and student-student interaction.

CONCLUSION

To summarize, although interaction among students has been studied most frequently, the various the forms and combinations of interaction discussed here would benefit from systematic and rigorous research using a variety of research tools and methodologies. Greg Kearsley (1995) provided a list of eight questions related to interaction, the answers to which are critical to the development of effective distance education programming. These questions relate to the effects of the frequency of interaction, types of students,
subject matter, and learning objectives to which interaction is most critical, as well as
the effects of interaction on student satisfaction. These questions can be answered with
reference to all the forms of interaction covered here, including those involving complex
feedback loops, as is the case in interactions associated with academic analytics. Additional
questions related to cost, time requirements, and other workload implications
are critical in an era of expanding distance education programming. Unfortunately, the
answers to most of these questions remain largely unanswered many years after Kearsley
posed them.

The quest for simple solutions that generalize to the many diverse contexts of dis-
tance education will likely prove to be futile. A growing mosaic of distance education
technologies and practices continues to develop, with no single best way to leverage or
even define interaction. Each institution, discipline, region, and user group is certain to
continue to develop unique cultural practices and expectations related to their need for
and use of interaction in its myriad forms. However, this is not to say that all applica-
tions and interactions are equally effective or efficient.

Daniel and Marquis’ (1988) seminal challenge to distance educators was to get the
mixture right between independence (student-content interaction) and interaction
(mainly student-teacher interaction at that early date). In the 21st century, we are dou-
ble challenged to identify the myriad forms and potentialities of interaction, and to
understand the equally complex possibilities for their effective combination. Approp-
riate combinations are expected to result in effective instruction and exciting new
educational opportunities; inappropriate combinations may be expensive, exclusive,
and exigent. Our responsibility as professional distance educators is to ensure that the
modes of interaction we explore, practice, and prescribe are related to the attainment
of educational objectives, are open to student diversity, are affordable to both students
and institutions, and increase access to education that is potentially deep, meaningful,
and fulfilling.

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