Interaction Paradigms for new Web Technologies: Shift Happens

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Abstract
The concept of “interaction” lies at the foundation of many theories and applications of computer and Internet technologies. Taking the specific example of those theories and applications associated with distance education and educational technology, this paper looks at the role of interaction as a kind of metaphor in educational theory and research. It takes as its starting point the idea that “interaction” represents a kind of research paradigm or “generative metaphor” that structures the way in which technologies are understood and applied, and in which research questions and problems are defined. Emphasizing the role this term has played in specifically in the theory and understandings of educational technology, this paper will consider to what degree the cybernetic and information-theoretical history of this term burdens and limits its semantics and morphology. It will consider alternative ways of understanding this term, and alternate metaphors that might be more efficacious. Surveying a range of literature, it considers the “generative power” or potential that might be gained from relational, contextual or ecological frames of reference. Instead of defining the research and practical challenges in terms of “closing” interactive feedback loops, or of “getting the mix right” between interactive forms, these metaphors offer new potential for understanding the manifold challenges and contexts associated with new “participatory” technologies and their application.

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Interaction: A short history of a concept

The term “interaction” has been in use as early as the mid-19th century (OED, 1987); and perhaps significantly, it has played an important role in the writing of John Dewey early in the 20th century. In his experientially oriented philosophy, Dewey understood interaction in terms of the reciprocal and dialectical interaction of objective and subjective conditions in experience. Any experience Dewey believed, is a kind of complex “interplay of these two sets of conditions,” which cannot be reduced to any stable structure or dichotomy, and is constitutive of what Dewey referred to as a “situation” (Knowles, Holton & Swanson, 1998, p. 95; Dewey, 1944, p. 167). As is made clear below, this understanding of interaction as a multi-dimensional, reciprocal engagement is rather different from the way interaction is understood in other technical contexts. Despite the importance of Dewey’s thought to education, his particular, dialectical understanding of interaction is not represented in its original, dynamic complexity in discussions of interaction in the literature of educational technology or distance education.

Instead, the application of the term “interaction” to educational technology --and its relevance to technology-enabled lifelong learning-- seems much more strongly and explicitly influenced by 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. 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 correlative] reflections upon psychology and the nervous system...” (Wiener, p. 23). Central to cybernetics is a particular understanding or model of communication which has been characterized as the “mother of all models” (Woods & Hollnagel, 2005, 11). This model was first described in “A Mathematical Theory of Communication” formulated by Claude Shannon in 1948 (Wiener, 1950). Shannon provides a diagram (figure 1) schematizing the chief components involved in communication as well as their interrelationship.
As Shannon (1948) explains it,

The fundamental problem of communication is that of reproducing at one point [the “destination”] either exactly or approximately a message selected at another point [the “information source”]. Frequently the messages have meaning [but these] semantic aspects of communication are irrelevant to the engineering system (p. 1).

It is itself significant that Shannon frames information exchange or interaction as an “engineering system” or “problem” and that this system is conceived as one in which the “semantic aspects of communication are irrelevant.” As we will demonstrate below, it is the character of research paradigms or generative metaphors that they carry with them thematic characteristics that are already evident at their point of origin.

It is also not surprising, then, that it is the character of this paradigm specifically as an “engineering system” -- with its exclusion of the semantic dimension of communication -- that is vital to Norbert Wiener’s use of the term. 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 or animal or mechanical, is a chapter in the theory of messages. (Wiener, 1950, p. 25)
Such an understanding, as Packer and Jordan (2000) explain, has “provided the conceptual basis for human-computer interactivity” and is “de rigueur for anyone investigating the psychological and socio-cultural implications of human-machine interaction” (p. xvii). It is in this form that the term “interaction” has been inherited in 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). In an article appearing recently in *Educational Technology* (2000), Michael Yacci puts it this way:

The information theory model has been valuable as a Rosetta stone for communication researchers in the areas of both human and machine communication. By forcing us to think about the structural aspects of communication, we have gained insight into both human and machine systems. (p. 6)

Another way of making this point would be to assert that the understanding of information and cybernetic theory --and the specific notions of communication and interaction on which it based-- have acted as a kind of paradigm or “generative metaphor” in educational technology research. This last term was coined by philosopher and organizational theorist Donald Schön (1979), who explains that generative metaphors are central to the construction of theories and research in complex domains. As Schön explains, such a term “names” and “frames” “a particular reality” (p. 264). It does so first by selecting “for attention a few salient features and relations from what would otherwise be an overwhelmingly complex reality,” and by giving these salient features their own “coherent organization” (p. 264).

In the case of the generative metaphor of “interaction,” this naming, framing and simplifying function can be seen to occur initially by employing Shannon’s diagram as a kind of conceptual “overlay” for the educational processes of communication and instruction. As such, the components in this diagram serve to identify particular entities and components comprising the manifold complexity of various educational contexts and events. The teacher is most obviously the sender, and the student, the
receiver, with various contents and technologies (lecture, postal services, radio, the World Wide Web, etc.) representing the information channel. An example of such a conceptualization is provided by a diagram of what is called "the traditional educational transaction" by Shale and Garrison (figure 2).

Having thus "named" and "framed" particular educational phenomena in this manner, educational theorists have gone on to apply and elaborate this basic explanatory framework in a variety of ways. One important elaboration is illustrated above by Shale and Garrison, who underscore the point that "communication" in educational contexts needs to be "two-way:" "The distinguishing feature of two-way communication is that each participant in the relationship is both a sender and receiver[, and that] true messages go in both directions" (p. 32). A similar development or elaboration of this metaphor is provided in Michael G. Moore's well-known outline of "Three Types of Interaction" (1989). Although Moore doesn't mention systems or information theory by name in introducing these three interactive types, the importance of this way of thinking is evident at many points. Perhaps the clearest indication of this fact is Moore's mirroring of Wiener's own tripartite scheme of "interactive dyads;"

I [suggest] that, as a minimum, distance educators need to agree on the distinctions between three types of interaction, which I labelled learner-content interaction, learner-instructor interaction, and learner-learner interaction. To distinguish among these three types will have benefits conceptually.... (p. 1)

Like Wiener's combinations of "man and machines, machines and man, and ... machine and machine," Moore identifies three interactive dyads in terms of learners and the system components with which they interact. In thus identifying these three types of interaction, Moore repeatedly underscores the importance of distinguishing between them, as well as between the technologies and instructional methodologies most appropriate to each:
The principle of specialization of teaching activity and use of communication medium must be applied to distinguish more deliberately among the three types of interaction described above. (p. 5)

It would be difficult to imagine a clearer illustration of the naming, framing and simplifying effects or consequences of the generative metaphor that cybernetics supplies to educational technologies. Out of the manifold and complex aspects, events and roles that make up technologically-mediated educational situations, Moore uses the concept of “interaction” to isolate and identify three distinct forms of interplay. By thus dividing up the kinds of activities that can otherwise form an undivided and complex totality, Moore very effectively selects and gives coherent organization to a relatively small number of salient features. More concretely, Moore’s identification of three specific interactive forms allow those conceptualizing and developing various forms of instruction to identify and organize the interactive components they may be putting to use accordingly.

However, a generative metaphor does more than just give a name and organization to a complex reality. Schön (1979) explains:

Together, the two processes [of naming and framing] construct a problem out of the vague and indeterminate reality... They carry out the essential problem-setting functions... they describe what is wrong with the present situation in such a way as to set the direction for its future transformation. (pp. 264-265)

In other words, generative metaphors not only highlight a few elements for attention from complex sets of phenomena, they also shape the kinds of problems --and ultimately, the kinds of solutions-- associated with them. This is already evident in Moore’s article; for his tripartite division of interactive forms leads him to emphasize the importance of what has since become a “titular” problem in the distance education literature; namely that of “getting the mix right” between interactive forms. Moore puts this as follows:

It is vitally important that distance educators in all media do more to plan for all three kinds of interaction, and use the expertise of educators and
communication specialists in both the traditional media, correspondence, broadcast and recording, and the newer teleconference media. (p. 6)

Titles from the distance education literature in which this same concern is underscored (either explicitly or implicit) include Daniel and Marquis' "Interaction and independence: Getting the mixture right" (1979), Woodman and Taylor’s article on “balancing the multimedia mix” in distance education (1999), or Anderson’s “Getting the Mix Right Again: An Updated and Theoretical Rationale for Interaction” (2003; see also Anderson & Kuskis, 2007).

A second example of a problem identified through the “generative” power of the interaction metaphor --one which has also found its way into article titles in the relevant literature (e.g. Dix, 1996) -- goes by the name of “closing the feedback loop.” The problem of closing the feedback loop between student and teacher plays a central role in a number of texts, including Shale and Garrison's (1990) mentioned above. In it, the authors emphasize that “in a true educational experience, the student [as well as the teacher] can transmit information, and in fact information is…transmitted both ways” (p. 35). The "problem" and its solution, then, is to ensure “that the communication loop between teacher and student is closed” (p. 36) as often and emphatically as possible.

**Interaction Solutions and Lifelong Learning Problems**

The problems, solutions and suggestions for practice and research emerging from the generative metaphor of “interaction” have been actualized in many settings -- both in online and conventional education. When planning an online program, for example, it can indeed be useful to consider how students can benefit from a mixture or variety of educational interactions or experiences, including group discussion or conferencing, textbook readings, and also direct contact with the instructor. In addition, in many forms of technologically-mediated instruction, it is often imperative for an instructor to be as responsive as possible to student requests during the delivery of a course.

However, the proliferation of technical forms and (often informal) learning activities and practices characteristic of Web 2.0 --or what have been called “participatory”
technologies—introduce new and complex dynamics that can be conceptually challenging. Referring to blogs, wikis, and social networking sites, the practices and technologies of Web 2.0 present to students and learners a bewildering range of possibilities for engagement and participation that extend beyond the boundaries of the institution and lend themselves to self-directed, lifelong and informal learning activities. As a corollary, these technologies and practices also present distinct challenges to the three modalities of interaction outlined above. What is the meaning of “student-content” interaction, for example, when a student can literally change an entry in Wikipedia relevant to her studies, and engage with the community that is maintaining the page or topic? Similarly, what is the status of “student-teacher” interaction when Web 2.0 environments do not readily distinguish between these roles? What, finally, would be the meaning of mixing and balancing these interactive modalities when their distinctive meanings have been so diluted?

Writing a number of years before the advent of Web 2.0 as a concept, Fischer (2001) emphasizes the need for conceptual change deriving from specific lifelong learning practices in a manner that is perhaps more apt today than it was a number of years ago:

Lifelong learning requires a deeper understanding of... fundamental human activities and their relationships with new media. It requires an integration of new theories, innovative systems, practices, and assessment. New intellectual spaces, physical spaces, organizational forms, and reward structures need to be created to make lifelong learning an important part of human life. (p. 8836)

Instead of the institutionalized supports and formalized roles and relationships that have been a part of more traditional forms of education, learning as ongoing online participation that is embedded directly in the intellectual and physical spaces in which we live and work everyday. Although Moore has commented on the potential of these technologies for distance education, he has not indicated how they might relate to his three interactive modalities (Moore, 2007). Choices, for example, between student discussion, readings and lecture are simply not possible in contexts where content is user generated, where discussions are open to public participation, and where podcasts of presentations are freely available in abundance. In addition, the otherwise valuable advice of Shale and Garrison to “close the feedback loop”
between student and teacher is also rendered problematic – not only for the reasons outlined above, but also for the simple fact that there will often not be an instructor involved to initiate and sustain feedback. Furthermore, in lifelong and informal learning contexts, in online and Web 2.0 settings, the idea of isolating elements such as teacher, material and learner -- as well as the interactions passing between them -- may itself even become challenging.

Finally, in addition to the difficulties presented by the application of this metaphor to informal learning via Web 2.0, “interaction” has frequently been noted to present ambiguities, challenges and conceptual difficulties within the fields of distance education and educational technology themselves. Referring to new forms of textual analysis, Yacci (2000) underscores this point, and associates it with broader theoretical difficulties, specifically in the field of distance education:

...the term interactivity is a loosely defined term that, according to Rose (1999), seems to deconstruct itself when closely examined. ... Many leaders in distance education echo Rose's...concerns more broadly: not only is 'interactivity' poorly defined but, in general, distance education suffers from a lack of theory. (p. 5)

Yacci's response to these significant challenges is a redoubled effort to expand and clarify the meaning of interaction and its sub-components in terms more directly reminiscent of those of Wiener and Shannon. For example, he makes explicit reference to Wiener's notion of feedback in underscoring the fact that true "instructional interactivity...does not occur until a message from and back to the student has been completed” (p. 2; emphasis in original). Similar responses can be readily found in the literatures of distance education, lifelong learning and educational technology generally. For example, Anderson and Kuskis (2007), seek to further clarify the metaphor of interaction by adding three more interactive types (teacher-teacher, teacher-content, content-content) to the tripartite division already defined by Moore. In doing so, these authors -- like Wiener some 50 years earlier— appeals to the fundamental substitutability or interchangeability of various interactive forms, and call for further research into each of the forms they have defined:
In the 21st century we are still challenged to get the mixture right –only now we must consider all six modes of interaction to try to which combinations are optimal in different situations. Each of the modes of interaction in distance education needs systematic and rigorous theoretical and empirical research using a variety of research tools and methodologies. Appropriate mixtures will result in increased learning and exciting new educational opportunities; inappropriate mixtures will be expensive, exclusive and exigent. Our responsibility as distance education professionals remains to ensure that the modes of interaction we practice and prescribe maximize the attainment of all educational objectives and increase motivation for deep and meaningful learning. (Anderson & Kuskis, 2007, pp. 304, 305)

By understanding teaching and learning essentially as a collection of comparable interactive processes—in terms of the exchange of messages and feedback in channels of communication—interaction becomes not only the problem, but also the solution and the paramount research question for teaching and learning online.

**Time for a Paradigm Shift?**

A metaphor or paradigm, as the work of Schön, Kuhn (1962) and others have made clear, is not something that is waiting to be discovered, that is written in stone, or that is somehow inherent in the phenomena themselves. Instead, a paradigm is collectively developed and socially constructed. This happens through our experience of the phenomenon in question (Lakoff & Johnson, 1980), and just as importantly, through research, theorizing and writing. Because a metaphor or paradigm is constructed, its value in research and practice is not established by virtue of its manifest technical or scientific “truth.” Instead, its value is primarily heuristic in nature, and accrues only as a result of the metaphor’s “generative” powers for explaining and organizing the domain, and for framing problems and potential solutions. As has been demonstrated above, the generative power of the interaction metaphor alone appears inadequate in the contexts of informal and lifelong learning associated with Web 2.0 technologies and practices.

At the same time, explicitly acknowledging that established terms like “interaction” are heuristically rather than objectively “true,” enables new and unfamiliar paradigms to compete with or complement these existing metaphors. And like the
term “interaction” itself, such alternative metaphors can then also be judged on the basis of their own heuristic and generative capacities.

In an article discussing “design paradigms” appropriate to the domain of “computer supported collaborative work” (CSCW), Moran and Anderson (1990) present a number of suggestions that closely parallel those currently being put forward by the authors of this paper. Moran and Anderson argue that as designers, every attempt should be made “to explicate the grounds for our design principles [or paradigms] rather than leav[ing] them intuitive or implicit” (p. 383). In seeking out an alternative paradigm specifically for “interaction,” Moran and Anderson describe the challenge of conceptualizing the manifold complexities of the everyday world of work and collaboration:

What we are striving for at this point is an articulation of a set of patterns that conveys the richness of the settings in which technologies live --the complex, unpredictable, multiform relationships that hold among various aspects of working life (p. 384).

Such rich and complex patterns and settings, of course, also define the ad-hoc, embedded and just-in-time situations typical of Web 2.0 technologies and practices. It is perhaps not surprising, then, that Moran and Anderson suggest the same paradigm that the authors of the current article are also putting forward. This is to use the “perspective of...the lifeworld (Lebenswelt)” as a possible, heuristic interpretive key. Another expert in the area of CSCW, Paul Dourish, advocates the use of the same term, and explains its meaning as follows:

The lifeworld is the intersubjective, mundane world of background understandings and experiences of the world. It is the world of the natural attitude and everyday experience. ...the source of meaning [in this world is not to be found in] a collection of abstract, idealized entities; instead... this world is already filled with meaning. (p. 106)

The lifeworld, in other words, is marked specifically by its intrinsic and concrete meaningfulness. This stands in clear contrast to the deliberate exclusion of “semantic
aspects” of interaction in the original abstractions or “engineering systems” proposed in information theory.

In their exploration of the “paradigm of the lifeworld” in computer-supported collaboration, Moran and Anderson (1990) cover a number of ways in which this term effectively “names” and “frames” the complex domain that it seeks to describe. For example, the authors distinguish between three different aspects of this world—namely, “technology, sociality and work practice” (p. 384). These categories, like Moore's three interactive forms, help to organize and “partition” the phenomena of computerized collaboration in a particular way. However, in contradistinction to Moore and those who follow in his footsteps, Moran and Anderson stress explicitly that these categories are “pragmatic” and “not fundamental” in nature (p. 384).

Moran and Anderson also provide examples of the ways that the paradigm of the lifeworld configures new issues and challenges that are clearly relevant to situations of lifelong learning. For example, their consideration of the lifeworld foregrounds the rather unconventional insight that “people deal with a complex environment by not attending to most of it most of the time” (1990, emphasis in original). This stands in clear contrast to conventional understandings of interface and interaction, which seem to implicitly assume that students are able to direct their undivided attention to the teacher, and then later, to content or to other students. At the same time, the notions of partial and peripheral awareness and participation highlighted by the metaphor of the lifeworld are of clear importance in lifelong learning and in the use of the Web 2.0 and other technologies associated with it. This is perhaps most obvious in terms of the learning enabled through participatory and mobile computing technologies whose use would be embedded in complex working environments.

Other examples of valuable insights resulting from this paradigm—considered in terms of collaborative work—can be found in other publications in domain of CSCW, including the book-length study of Paul Dourish (Where the Action is: the Foundations of Embodied Interaction). Instead of drawing predominantly from systems and computer sciences, this research makes extensive use of the human sciences that focus on meaning and experience—specifically ethnomethodology and phenomenology, but also other theoretical frameworks as well.
Conclusion

Emerging technologies such as Web 2.0 and mobile computing, combined with embedded and other integrated forms of technology use, present significant challenges for distance education, educational technology, and for other areas of research and design in online technology. The very novelty of these technologies makes them difficult to conceptualize and study using established research paradigms. By bringing new research metaphors and paradigms to bear on these technologies and practices, it is possible to understand them in novel, innovative and productive ways.

However, in order for these metaphors to be put to use, it is also necessary to change prevailing approaches to metaphors and paradigms themselves in research related to online technology. First, it is necessary to recognize that these metaphors are in fact used, or rather constructed, in and through research. It is important, in other words, to apply broadly “constructivist” understandings --familiar in theories of instruction and learning-- to our own “learning” that occurs through research. Second, the value of both dominant and emergent paradigms for research needs to be understood as being essentially heuristic. The legitimacy of these paradigms and metaphors derives neither from any objective “truth,” nor from related engineering and technical-operational values or principals.

It is only in these ways that research into online technology generally --and educational technology in particular-- can benefit from a plurality of generative metaphors that are available from different intellectual traditions, whether these traditions are technical or humanistic in their orientation. And it is also only in this way that metaphors and paradigms will be able to shed their reified rigidity, and be able to “shift” to address the similarly shifting and changing worlds and requirements of digital technologies and human engagement with them.

Author's Bio

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