Evolution of Research in Distance Education: Challenges of the Online Distance Learning Environment

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Our Time in the History of Distance Education
We live in one of the most exciting, and promising times in the history of our discipline. The field has reached this important point because of a fundamental shift in its conceptualization, theory and research. A nexus of computer and telecommunication technologies has made global e-learning possible. This new learning environment promises to make anywhere and anytime learning available to millions of students in a truly global scale. Furthermore, it has made unprecedented forms of collaborative learning and teaching available to teachers and learners. In this presentation, I will review the research in distance education which has brought us to this important point in the development of our field; and review the challenges ahead of us brought about by online learning.

Theory Building and Research in Distance Education
Primarily due to recent contributions made by leading theoreticians of the field, we now have a more complete and richer understanding of distance education. I am referring here to the work of the late Dr. Charles A. Wedemeyer (1981) who was Professor of Education at the University of Wisconsin, and Dr. Michael G. Moore (1983) the Director of the American Center for the Study of Distance Education at Pennsylvania State University. Their efforts in theory building and research expanded the theoretical base of the field from a physical science to a social science concept of distance education.

In its physical science interpretation, distance in education is defined by the geographic separation of the teacher and the student. This geographic separation is in fact real, and defines a fundamental characteristic of our field. However, if this concept is not enhanced with the social science interpretation of distance education it leads to several theoretical, methodological and practical contradictions, dichotomies, and unresolved problems.

In the social science interpretation of the field, distance in education is defined by the quality of communication between the teacher and the learner. Generally speaking, if the quality of communication between the two is improved distance is minimized. If the quality of interaction between the two deteriorates distance increases. Dr. Moore calls this distance a “transactional distance;” a useful concept to which we will return later in this presentation.

Geographic distance per se, however, does not have the same effect. We speak of face-to-face education. This is when the teacher and the learner are in close geographic proximity. Some assume that this geographic proximity has a magic effect on the quality of instruction and learning. Improving it; that is brining the teacher and the learner closer and putting them, shall we say nose-to-nose,
however, does not improve the quality of instruction and learning. Conversely we can set them apart miles, hundreds, if not thousands of miles and if the quality of their communication does not suffer, the quality of teaching and learning does not deteriorate either.

As such the physical science concept of distance education has limited utility in our understanding of the field, and we are truly fortunate to live at a time that a new social science paradigm in distance education is emerging. How did we get to this point? How did we go through such a profound shift in our understanding of the field? How does this shift play in the new teaching and learning environments created by the Internet and its capability to connect millions of learners and teachers online? I will try to respond to these questions in the next few minutes.

Stages of Evolution in Distance Education Research and Theory
Our field of study has a long standing tradition of research and development, which for the sake of analysis can be divided in three stages:

1. Comparative studies
2. Research on learner traits, and media variables
3. The emerging era, brought about by new communication and computer technologies.

In the rest of this presentation, I will briefly describe each of these stages; and explain their importance to current developments. These stages, however, are useful for analytical purposes. They do not define certain historic periods. For example, although more comparative studies were conducted between the 1950’s to the 1980’s than in the past 20 years, these types of research projects are still pursued by some researchers. Let’s take a closer look at them, and see how they contributed to our current understanding of distance education.

Comparative Studies
In the 1960s, Wilbur Schramm conducted a number of studies which compared instructional television (ITV) with classroom instruction. Also, Schramm (1962) summarized the results of more than 400 "scientifically designed and statistically treated comparisons of ITV and classroom teaching" (p. 66). He concluded: “we can say confidently that students learn from it, and that they learn fast and efficiently" (p. 66). Furthermore, “the conclusion has been 'no significant difference' between learning from television, and from classroom teaching" (p. 66).

After Schramm arrived at this conclusion many other researchers have compared classroom instruction to distance education since the 1960’s. Well over 2000 comparative studies have been reported the same results. Wetzel, Radtke, and Stern (1994) have summarized the results of comparative studies until the mid 1990s. They reported that there is no statistically significant
difference between distance education and other forms of education. A recent example is a study conducted by Johnson, Aragon, Shaik, and Palma-Rivas (2000). Researchers in this study compared learning outcomes of an online course with a similar course taught face-to-face. The study concluded that “there was no difference between the two course formats in several measures of learning outcomes” (Johnson et al., 2000, p. 29). Another recent meta-analysis of 19 studies out of an original pool of 700, which met the carefully selected criteria of authors, Machetmes and Asher (2000) confirmed previous conclusions that “there does not appear to be a difference in achievement between distance and traditional learners” (p. 43).

These studies established that students learn at least from mediated and distance education as they learn in what is commonly referred to as face-to-face, traditional, or on-campus education. Although we still conduct such studies, they reached a point of diminishing return in the early 1970’s.

Research on Learner Traits, and Media Variables
In the 1970’s, with more studies showing the same results, researchers started paying attention to learner traits as well as media variables. In what we might describe as the second stage of research and theory building in distance education, and mediated instruction, researchers became increasingly interested in individual learner traits. Studies published by Salomon and Snow (1970); Snow and Salomon, (1968); Salomon (1969, 1971); Cronbach and Snow (1977); Snow, Federico, and Montague, (1980); and Snow (1989) were based on the idea that if learner traits are paired with the right treatment attributes (mediated or otherwise), instruction could lead to a better control and prediction of learning outcomes.

This line of research, also known as aptitude-treatment interaction (ATI) clarified several issues related to cognition and mediated instruction. It also revealed the potentially unlimited combinations of cognitive states with media variables, thus defying parsimony and closure in explaining the impact of media on learning. In 1985 Clark and Salomon presented a comprehensive review of research in media and teaching and called this phenomenon “confounding variables.” Snow summarized the strengths and weaknesses of ATI research in the following as quoted in Kearsley (1994).

1. Aptitude treatment interactions are very common in education.
2. Many ATI combinations are complex and difficult to demonstrate clearly, and
3. No particular ATI effect is sufficiently understood to be the basis of instructional practice.

Commenting on more recent research evidence conducted in the late 1970’s and 1980’s, Jonassen and Grabowski (1993) also acknowledged the complexity generated by ATI matching. “ATIs also interact with processing requirements of the learning task to produce complex performance differences.” (pp. 30.)
Online Distance Learning
The complexity in distance education, however, does not end in the seemingly infinite variables describing the communicative relationship of the teacher and the learner. It goes far beyond that. There are other complex sub-systems involved in our profession. We use hardware, software and telecommunication technologies to create instructional programs and use them within an educational enterprise that is subject to social, and financial policies in a particular social system, which in turn is a member of the global community.

These complex relationships are presented in a set of nested and hierarchical subsystems, which have their own internal behavior, but each is affected by the behavior of all the other "levels", and affects the behavior of all the other levels. (See Figure 1)

Figure 1- Hierarchical Subsystems of Distance Education

Complexity of Online Distance Learning
Nowhere these complexities are more evident than in the online distance learning environment. Both instructors and learners are afforded novel means and ways of teaching and learning in such an environment. These affordances include:

- Immediate access to potentially unlimited sources of information
- Access to increasingly interactive sources of information powered by databases, and simulations
The specter of personalized learning, and
The possibility of just-in-time learning

In addition, the online distance learning environment has opened the door to a range of group communication that was not available before. These affordances include:

- Learner - learner online dialog
- Instructor – learner online dialog
- Collaborative learning among students
- Developing, and maintaining learning communities, and
- Developing and maintaining communities of practice and life-long learning

Furthermore, in the online environment, units of analysis for research and development are breaking down. New affordances leading to this development include emergence of:

- The concept and the possibility of creating learning objects
- The new mark-up languages and standards, such as XML, SCORM and others that would standardize learning objects, and
- A Variety of new software that provide a range of educational services such as, self-evaluation, meta-cognition, knowledge management and performance support systems to the learner and the instructor

No longer would the familiar college course, for example, fit the availability of these new solutions.

Online distance learning is fundamentally different than other forms of education. It is potentially, anytime, anywhere, and global. It crosses national, institutional, and conceptual boundaries and challenges the policy maker with a host of new issues ranging from copy and intellectual property rights to transfer of credit from one institution to another to the changing role of the teacher and the learner, and the list goes on.

How would the researcher go about understanding these complex interwoven relationships? How anyone could bring all these variables under the same umbrella and make sense of this concept we call online distance education? How would online distance education relate to other forms of teaching and learning at a distance? What if some of the teaching and learning is online, and some face-to-face? Where does video conferencing fit in all of this?

**System Methodology**
The world we live in is complex, but not complicated. It is also dynamic. That means it changes constantly. Online distance education is no exception. A robust paradigm is needed to support the field in the foreseeable future, and explain its
dynamic and complex nature. Systems methodology has been used for understating many complex phenomena ranging from

- biological organisms (Bertalanffy, 1988) to
- industrial manufacturing (Forrester, 1961);
- developmental learning (Smith and Thelen; 1993);
- cognition and action (Thelen and Smith, 1994);
- learning (Kelso, 1995);
- purposeful management (Ackoff, and Emery, 1981);
- education (Banathy, 1992; Salisbury, 1990) and a host of other economic, social, and natural phenomena (Meadows, Behrens, III, Meadows, Naill, Randers, Zahn 1974; Meadows, and Robinson, 1985).

In distance education, Coldeway, (1990), Vazquez-Abad, and Mitchell (1993), and Moore, and Kearsley (1996) called for approaching distance education from a systems point of view, and using systems methods to understand its complexity.

In a comprehensive study that Dr. Moore (1983) conducted in 1973, he reviewed more than 2000 published articles about education at a distance, as well as adult, and continuing education. He realized that in all of these studies there are two primary variables, which defined the relationship between the teacher and the learner. He called them structure, and dialog.

Structure is the control an instructor needs to impose on a teaching-learning session in order to enable the learner to achieve the desired goals.

Dialog is the autonomy that the learner needs in order to reach the desired goals. Some students are more autonomous, and need less structure, some require much more structure, and are not comfortable with too much autonomy.

Dr. Moore hypothesized that distance in education is defined by these two factors. When structure is increased dialog is decreased, and when dialog is increased, structure is decreased. Furthermore, the relationship between these two variables defined transactional distance. That is, when structure is increased, transactional distance is increased, and when dialog is increased, transactional distance is decreased.

I came across Dr. Moore’s study in 1984, and decided to apply system dynamics to verify the hypotheses set forward by him. System dynamics was developed by Professor J. W. Forrester at the Massachusetts Institute of Technology (Roberts, Andersen, Deal, Garet, & Shaffer, 1983). Originally, he used it to understand manufacturing systems, but since the 1960’s, it has been applied in a variety of disciplines in physical, and human sciences.
Using a system dynamics causal loop diagram, I represented transactional distance as shown in Figure 2. This diagram shows the inverse relationship between dialog and structure.

Figure 2- Causal Loop Diagram of Transactional Distance

In Figure 2, there is a negative feedback loop between structure and dialog. A negative feedback loop provides the control mechanism as how much transactional distance is desired and required at each point in time. If the learner needs more direct instruction, structure as well as transactional distance increases. If the learner requires more autonomy, transactional distance decreases as dialog increases, and structure decreases.

This is just one illustration of how systems methodology could provide new insights in the field of distance education, and effectively reconcile theoretical and practical issues. This diagram shows among other things, that in systems approach to distance education, what is important is not the geographic separation of the learner and the teacher but the quality of their communication. This would hopefully resolve the issue of comparative studies between distance and f2f instruction.

In a study that was published in 1996 my colleague Rick Shearer and I used discourse analysis to collect data for verifying Dr. Moore’s hypothesis. The study, tentatively verified this inverse relationship for 30 subjects who went through an online teaching and learning session each lasting 30 minutes.

Currently, I have expanded the use of simulation software to include agent-based technology, such as in StarLogo for programming the traits of each learner and observing their adaptive behavior. We hope to be able to feed the data generated in StarLogo to a system dynamic model for further exploration.

**Synergy in Research Strategies and Data Collection Methods**
The type of data we selected to feed the system model was generated by analyzing the discourse between the instructor and the learner. Discourse analysis is a method by which speech acts are analyzed and attributed to specific system variables. In the example here, speech acts of the instructor were attributed to structure, and those of the learner to dialog. Thus, if the instructor was direct and controlling, structure would increase; and if the learner was active and engaged dialog would increase. Conversely, if the instructor was indirect and inquisitive structure would decrease, and if the learner was passive and disengaged dialog would decrease.

While I have been engaged in this line of enquiry, other colleagues have also been involved in research based on a social science paradigm of instructional technology. They have also opened new lines of inquiry that are based on analyzing the dialogical communication among learners, and between teachers and students. These researchers have used

- student self-reporting through a survey study, (Fulford & Zhang, 1993; Gunawardena, 1995),
- extensive interviewing of students (McDonald & Gibson, 1998),
- conversation and discourse analysis (Chen & Willits 1999; Tsui & Ki, 1996)
- or a combination of these methods to collect the necessary data.

These methods indicate a clear break from the traditional experimental studies for understanding important factors in learning online. Furthermore, these studies are focused on a smaller group of subjects, but take a deeper look at the subjects' verbal and written behaviors.

These studies borrowed heavily from conceptual and analytical methods of a related field to online distance learning –that of computer mediated communication. Leading researchers in the field, such as Linda Harasim, Murray Turoff, and Starr Roxanne Hiltz explained the conceptual underpinnings of the social environment of online education (Harasim, 1990), and used a variety of methods, such as, conceptual maps to analyze and categorize discourse oriented collaborative knowledge generation in computer mediated environments. (Turoff,. Hiltz, Bieber, Fjermestad, and Rana, 1999). Other pioneers in studying computer mediated communication, such as Zane Berge (2001) have provided research-based, and theory oriented guidelines for designing online discussions. This analyzing the discourse between the teacher and learner, and among students has emerged as a useful, practical and functional method of data collection for online distance education.

I began this presentation by stating that we are witnessing an exciting, and promising time in the history of our discipline. The promise of this time, partially resides in the application of existing methods, or developing new ones to better understand our field. Methods that were not considered as “scientific” before are
providing valuable knowledge and insight, today. For example, Helen Brown (2001) of the British Educational Communications and Technology Agency used action research to chronicle and report the development of a collaborative learning network for continuing professional development. She chose to report the result of the study in the format of a reflective “story

I have provided here a short overview of and examples of how action research, self-reporting, in-depth interviews, self-reflection and story telling are used as strategies by researchers and discourse analysis as a method to foster the social science paradigm of online distance education. As the 21st century unfolds more novel means and ways in understanding distance education will emerge. However, I believe the system dynamic paradigm that I presented here has the theoretical and methodological robustness to absorb emerging methods of research, data collection and analysis and make them useful to researchers and practitioners by making complexity manageable.

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