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13:7. The Uses of Systems Theory in Distance Education: An Annotated Bibliography

Editorial

Periodically discussion resumes around the question of whether there is a need for theories unique to the field of distance education or whether distance education is a practice that better lends itself to the application of theories from other disciplines. In this issue of DEOSNEWS Steven Shaffer, a doctoral student in Penn State's Adult Education program, reviews selected literature related to systems theory as it applies to (or could be applied to) distance education. This annotated bibliography will be a useful resource to both those seeking an introduction to this theory and those considering it as an interdisciplinary explanatory framework for research related to distance education practice.

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The Uses of Systems Theory in Distance Education: An Annotated Bibliography

Introduction

Systems theory, system dynamics, and similar phrases are often found in the literature of education (in general) and distance education (in particular). Sterman (1994) offers an excellent, detailed introduction to the use of systems theory in education. However, a review of the literature shows a wide divergence in understanding of the subject. Systems theory was initially developed by biologist Ludwig von Bertalanffy as a rigorous method of describing the structure and mechanisms of complex systems. He was very concerned about "the danger that general system theory may end up in meaningless analogies" (p. 35) and was at pains to point out that "general system theory is not a search for vague and superficial analogies" (p. 35). Seemingly, many authors (not just in distance education) have not heeded his exhortations.

For example, Land and associates (2003) attempt to describe distance learning from a systems perspective, but are less than completely successful. Mentions of systems theory are interspersed with some fairly straight-forward suggestions regarding managing change. While the techniques offered are useful, theydo not address the dynamics of distance learning.

There are, however, some excellent examples of the application of systems theory available. Saba & Shearer (1994) demonstrate a willingness to go beyond simple relationships and to attempt to fill in some of the more complex details of the distance education process. Anderson (2004), though not using the phrase systems theory,

describes a deeper-than-average approach to studying distance education. King & Frick (1999) demonstrate the use of SIGGS, a complex modeling approach based on 201 "hypotheses concerning relationships among properties of educational systems," originally developed by Maccia & Maccia. Frick's work (which can also be accessed online at http://education.indiana.edu/ist/courses/r695fric.html), shows promise in applying systems theory to drive theory development in educational contexts.

Following Moore & Kearsley's (2004) admonition not to venture into a territory without a map, I suggest that anyone interested to use systems theory as a theoretical framework for research review the publications cited below, and the attached annotated bibliography. Those new to this subject should start with the Saba & Shearer article and then progress to the Sterman article. Together these will provide enough background to understand the other articles.

Introduction References

Anderson, T. (2004). Toward a theory of online learning. In *Theory and Practice of Online Learning,* Retrieved April 15, 2004 from http://cde.athabascau.ca/online_book/.

Banathy, B. H., & Jenlink, P. M. (2004). Systems inquiry and its application in education. In D. H. Jonassen (Ed.), *Handbook of Research on Educational Communications and Technology,* second edition (pp. 37- 57). Mahwah, NJ: Lawrence Erlbaum Associates.

King, K., and Frick, T. (1999). Transforming education: Case studies in systems thinking, AERA annual meeting, Montreal, Canada.

Land, D., Nwadei, A., Stufflebeam, S., and Olaka, C. (2003). Socio-technical system advancements: Making distance learning changes that count. Retrieved March 15, 2004 from http://www.usdla.org/html/journal/JAN03_Issue/article03.html.

Saba, F. (1999) Toward a systems theory of distance education. *The American Journal of Distance Education, 13,* (2). 24-31.

Saba, F. & Shearer, R. (1994). Verifying Key Theoretical concepts in a dynamic model of distance education. *American Journal of Distance Education, 8* (1), 36-59.

Sterman, J. D. (1994) Learning in and about complex systems. *Systems Dynamics Review, 10.* 291-330.

von Bertalanffy, L. (1968). The meaning of general system theory. In *General System Theory.* George Braziller: New York.

Annotated Bibliography

Anderson, T. (2004). Toward a theory of online learning. In *Theory and Practice of Online Learning.* Retrieved April 15, 2004 from http://cde.athabascau.ca/online_book/.

This chapter is a good example of the beginnings of a theory of online learning. The author believes that any such theory would be premature at this point; however, "the creation of a model is often the first step toward the development of a theory." This book chapter does offer such a model, combining attributes of learning with the "affordances" of the Net, together with a theory of the role of interaction in online learning. Building from the work of Moore, the author elaborates a model of the interaction between the three "agents" in educational interactions: teacher, learner and content, creating six possible interactions (learner-teacher, teacher-content, etc.) Next, the author describes a more complex model which includes the "knowledge/content interface" and aspects of communication and outside support. Generally, although the author does not use the phrase *system theory*, this model would be a good basis on which to build a system theory of online learning. As the author summarizes, "The model presented illustrates most of the key variables that interact to create online educational experiences and contexts." The chapter concludes with a call to develop a full-fledged theory. 55 references.

Baker, R. (2003). A framework for design and evaluation of Internet-based distance learning courses; Phase one -- framework justification, design and evaluation. *Online Journal of Distance Education Administration*, 6, 2. Retrieved November 15, 2003 from http://www.westga.edu/~distance/ jmain11.html.

This article discusses the problem of evaluating the quality of Internet-based distance learning courses. Most of the quality comparisons performed thus far are focused on the grade that students receive; however, this doesn't really resolve the issue. What is needed, according to The Council for Higher Education Accreditation, is the answer to two questions: (1) What is an effective framework for distance learning? and (2) How can quality be evaluated and insured? In order to develop a framework, the author begins with the work of Ralph Tyler and the oft-cited Bloom's taxonomy, which is difficult to apply to distance education classes due to a number of logistical issues.

The author provides a short but good review of Bloom's taxonomy and Tyler's objective-centered principles of curriculum and instruction, then discusses the work of other theorists, describing a goal-oriented approach to curriculum development, emphasizing measurement. He then combines these ideas into a general framework, incorporating twenty five criteria for assessing distance learning curricula. Using a sample lesson from The Virtual High School (www.govhs.org), he demonstrates the evaluation method. In the analysis and conclusions section, he indicates several problems with the framework and outlines expected future work. One of the issues he raises is the Boolean nature of the evaluation method; that is, a lesson gets a pass/fail score for each of the criteria.

The approach this article takes is very goal-oriented, quantitative and taxonomic; as such it could result in an uninspired, "cut and paste" approach to lesson design ("add one part reward, two parts practice, etc.). While frameworks are generally a good idea, they should not substitute for knowledge, creativity, and a passion for teaching.

Banathy, B. H., & Jenlink, P. M. (2004). Systems inquiry and its application in education. In D. H. Jonassen (Ed.), *Handbook of Research on Educational Communications and Technology,* second edition (pp. 37- 57). Mahwah, NJ: Lawrence Erlbaum Associates.

This book chapter is divided into two parts, entitled Systems Inquiry and The Systems View and its Application in Education. The first part discusses three related disciplines: systems theory, systems philosophy, and systems methodology, giving a good overview of the history, theories, and nomenclature of each. The authors discuss the varied roots of systems thinking, including biology, economics, engineering and philosophy. A number of references to primary sources are given. Part two of this chapter discusses the uses to which systems approaches have been put in education; the authors discuss what they refer to as "a comprehensive system of educational inquiry" and proceed to discuss how system models should be used in education research and policy-making. I use the word "should" here because the authors are quite prescriptive and conclude by exhorting that "rather than improving education, we should *transcend* it" (italics in original). Ironically, the authors' suggestion with regard to the use of a systems approach is reminiscent of the "social engineering" fad of the 1960s and 1970s, which these authors criticize strongly. Although system modeling of education has the potential to allow us to test small "tweaks" to policy before implementing them, thereby allowing for continuous process improvement, the authors' advocating of a large scale redesign of the educational system does not take into account the very complexity of the problem that systems approaches allow us to grasp. 102 references; bibliography with an additional 82 works.

De Laat, M., & Lally, V. Complexity, theory and praxis: Researching collaborative learning and tutoring processes in a networked learning community. *Instructional Science, 31,* 7-39.

This article elaborates and demonstrates an approach to researching learning and teaching that combines several approaches (e.g., social constructivism, content analysis, and critical event recall). The authors claim that an on-line educational experience is too complex to be adequately captured by any one theoretical framework, and they make the case for triangulating using multiple approaches. They then demonstrate this approach using a research project in which they perform both a content analysis (via semantic coding) and create a thick description of the thought processes of the tutor (instructor) during the 10-week course. This approach provided both quantitative and qualitative information. The result is a thicker picture of the experience than perhaps could have been obtained by doing only one or the other. From a quantitative standpoint, the results are probably not generalizable, since they only had 7 participants; also, their method of sampling 10% of the 1000 messages posted during the course may not be valid. However, the paper makes a strong case for using multiple approaches in studying distance learning. Two appendices and 64 references.

Frick, T. (1995). Understanding systemic change in education. Retrieved August, 2004 from http://education.indiana.edu/ist/courses/r695fric.html.

This introduction to systems theory in education discusses the author's plan to develop educational theory in a simulation environment. Drawing from the work of Maccia & Maccia, who propose 201 "hypotheses concerning relationships among properties of educational systems," he proposes to build software simulations of the complex interrelations within an educational system, and to use these simulations to help educators and administrators to propose innovations within their systems. An important aspect of why this approach has not been developed thus far is that most people do not think in a systems manner (he refers to the work of J. Hart but does not give references to it); the author contends that a "paradigm shift" in thinking must occur before an approach such as his will gain general acceptance. (16 references)

King, K., and Frick, T. (1999). Transforming education: Case studies in systems thinking, AERA annual meeting, Montreal, Canada.

This paper presents examples of using the SIGGS educational system modeling approach in two diverse educational settings: an elementary school classroom and a museum school. The authors discuss the complexity of the model and make an argument for its usefulness. Using their modeling approach, the authors demonstrate the differences between educational contexts and also propose that the results of these educational situations could have been predicted from the models. The authors then use the models to make a case for a radical change in educational theory which is similar to constructivist arguments. (17 references)

Land, D., Nwadei, A., Stufflebeam, S., and Olaka, C. (2003). Socio-technical system advancements: Making distance learning changes that count. Retrieved March 15, 2004 from http://www.usdla.org/html/journal/JAN03_Issue/article03.html.

This article attempts to describe distance learning from a systems perspective, but is not completely successful. Mentions of systems theory interspersed with some fairly straight-forward suggestions regarding managing change. The authors, summarizing Bertalanffy, state that “systems theory allows understanding of the structure and dynamics of all systems, allowing for the observation of relationships between various elements of a system viewed holistically versus elementally segregating isolated aspects of the overall system,” yet do not address the dynamics of distance learning at all. What they do offer are checklists of suggested modifications to policies and faculty strategies, along with a list of “keys to success,” including such items as “a positive attitude about overcoming obstacles and challenges” and “universal and user-friendly technology support.” Although these are undoubtedly good suggestions, there is little or no attempt at incorporating these ideas into a systems theory of distance learning. This article exemplifies a class of publications that purport to utilize systems theory but in fact offer little or nothing systematic. It is still an open question as to whether or not it is legitimate to apply systems theory to distance learning; however, if one claims to be doing so, one should provide more substantial evidence of the attempt. (23 references)

Luppicini, R. J. (2002) Toward a conversation system modeling research methodology for studying computer-mediated learning communities. *Journal of Distance Education, 17*(2): 87-101.

This article discusses a conversational modeling approach to studying distance education. The author discusses two innovations in research methodology and then proposes a framework combining them. Of particular interest for this annotated bibliography is his overview of second-order cybernetic modeling, which "views knowing as a process of continual construction that maintains itself in the presence of (enabling or frustrating) perturbations from the medium in which it resides." In an important bow to social constructivists, Luppicini adds that "knowledge is embedded in a circular social practice that involves thinking and acting beings." This section of the article is a short but useful description of one of several systems-theoretic approaches, and includes a diagram which is a good example of a non-trivial learning feedback system. The rest of the article is an interesting preliminary proposal, the usefulness of which will need to be validated in practice. 35 references.

Saba, F. & Shearer, R. (1994). Verifying key theoretical xoncepts in a dynamic model of distance education. *American Journal of Distance Education, 8* (1), 36-59.

This paper attempts to lay the groundwork for an dynamic model of distance education that can be validated empirically. The authors state that "research in distance education has been primarily program based" and that the few empirical studies have measured factors such as stakeholder satisfaction. They propose that in order for the field of distance education to mature, there is a need for empirical studies to verify the conceptual foundations of the field.

The paper begins with a brief overview of Moore's concepts of *transactional distance*, *dialogue* and *structure* and the subsequent work of Saba to use a systems dynamics approach for representing the interactions among these factors. The authors then gives a brief introduction to system dynamics, which they summarize as "a technique for translating intuitive models into causal loop diagrams in which the effect of one system component on other functions is clearly illustrated by positive or negative feedback loops." A very good but brief summary of the use of system dynamics in distance education is then presented. System dynamics allows for modeling and predicting future states and incorporating complex political, social and economic forces. The paper continues with a discussion of discourse analysis, which is used to define and measure the key variables in the study. A brief discussion of the history of discourse analysis in distance education research is presented.

The researchers studied the following components of a distance education system: transactional distance, learner control, and instructor control. These were measured along the continuums of structure/dialogue, active/passive, and direct/indirect respectively. Systems dynamics modeling software was used to develop a model of the interactions between the proposed variables. They then performed an experiment to try to validate the hypotheses, resulting in some preliminary success.

The main value of this paper is its attempt to create a non-simplistic model of distance education and to begin to validate certain assumptions in the model. As the authors note, the model is still too simple, but it lays the groundwork for future work in this area. 29 references.

Saba, F. (1999) Toward a systems theory of distance education. *The American Journal of Distance Education, 13*(2). 24-31.

This article discusses the difference between a systems view and what the author refers to as the "physical science" view of educational technology. After briefly discussing some of the history of this approach, the author then some methodological concerns. Chief among these is the limiting nature of the reductionist approach (which he claims is inherent in the physical science view). Although he doesn't use this term, he in effect charges that the physical science approach to educational research lacks "ecological validity" because the tasks that subjects are asked to perform are decontextualized. "The organism," he states, "is treated like a machine whose task is to associate inputs and outputs" (p. 27).

Another problem with reductionism, Saba points out, is that "the imperative of time in all aspects of human existence, including learning, is rarely brought into the picture" (p. 28). Here the author seems to be referring to that aspect of learning which happens inside of a delay loop; this type of phenomena is better modeled using a system dynamics approach. He concludes the article with what could be used as the "mantra" of systems theorists: "The data points representing many variables interacting are numerous; what is of interest, however, is not each data point, but the pattern that emerges from observing each individual learner" (p. 30). 25 references.

Sawchuk, P. H. (2003) Informal learning as a speech-exchange system: Implications for knowledge production, power and social transformation. *Discourse & Society, 14*(3). 291-307.

This article provides a good example of systematic analysis of conversation in an educational environment. Sawchuk begins by discussing some approaches to studying informal learning, noting that "most often researchers are dependent on learners' common sense accounts of their own learning." He goes on to suggest (though without references) that "from a basic cultural-historical perspective, what participants consciously make of a situation does not provide an adequate account of the learning process." As an alternative, he analyzes a conversation between two self-directed students attempting to learn how to do a mail merge function in a word processor. Using this analysis as an example, he proposes that informal learning is differentiated from formal learning in that there is not a central authority controlling the conversation and that in informal learning, the participants "develop a distinct level of tolerance for ambiguity." Overall, the article makes good points, although references to Vygotsky's zone of proximal development are not well integrated into the rest of the argument. 42 references.

Smith, M. (2004). Peter Senge and the learning organization. In *The encyclopedia of informal learning.* Retrieved August, 2004 from http://www.infed.org/thinkers/senge.htm.

This article discusses Peter Senge's concept of *the learning organization*, especially as developed in his popular book *The Fifth Discipline*. The aspect of Senge's work which is of interest here is his discussion of the necessity of systems thinking in an organizational context. He points out, as do others (see, e.g., Saba, 1999 and Sterman, 1994 elsewhere in this bibliography), that one of the most important aspects of systems theory is the delay between an action and a result; many decisions are based on looking at the result in a relatively short time span. Senge proposes that many of us never see the results of the most important decisions that we make. Systems thinking gives us a way of working through the consequences of our decisions in a longer term and more holistic manner. He advocates the use of system maps as a way of symbolizing the interrelations between the elements of an organization.

Systems thinking is the fifth of the five disciplines that Senge discusses; the other major discipline of interest here is mental models. He advocates focusing on our own biases and "deeply ingrained assumptions" in order to challenge ourselves and our co-workers to rethink them.

After a good general introduction to Senge's work, the article discusses several of the arguments against it. Chief among these are: (1) Are most people really able to adopt this kind of thinking; (2) If they can, will they want to?; and (3) Senge does not deal with the broader political and social context of decisions made within an organization.

Overall, this is a good introduction to a "practical" use of systems thinking, and may lead the reader to investigate Senge's original works. (26 references, plus 8 links to related web sites)

Smith, P. and Dillon, C. (1999) Toward a systems theory of distance education: A response. *The American Journal of Distance Education, 13*(2). 32-36.

This article is a response to the article by Saba (1999). In it, the authors defend what Saba had referred to as the "physical science" approach to educational research. Their main defense is that such research is *necessary*, though not *sufficient*, in order to develop an overall model of the distance educational processes: "Thus, we argue that distance education must be examined as a system, but to do so requires looking at the system and the variables that make up the system, sometimes a few at a time" (p. 34).

Arguing for the "no significant differences phenomenon," the authors state, from a pragmatic perspective, that "administrators, politicians, and taxpayers will continue to want to know if the latest technology works as well as the status quo" (p. 36). However, they reveal what may be a weakness in their argument when they also claim that "predictive theory in distance education is premature and, perhaps, in the strictest sense, unattainable" (p. 35); an argument could be made that this "unattainable" goal is exactly what the politicians and taxpayers think they are paying for in such research.

Overall, the authors make a good point: one can not have an overarching theory without some data to construct it from; however, the main point of Saba's article (though he does not state this explicitly) is that much research is published as disembodied pieces of information that lack any coherence.

Spector, J. M. (1998) The role of epistemology in instructional design. Instructional Science, 26. 193-203.

This article discusses the epistemological assumptions implicit in the design and use of software-based authoring environments (aka courseware). The author does a good job of explaining the issues, both philosophical and psychological. From a philosophical standpoint, epistemologic issues revolve around questions about "the nature of truth, … the implications for knowledge attributes, … and the nature of being a person (including accounts of reason and consciousness." Psychologists, he points out, instead wish to understand the nature of human thought processes. The article then goes on to analyze some of the foundational aspects assumed by courseware, especially the notion that they "might imply that what is required as a basis for instructional expertise is an appropriately elaborated semantic network of a knowledge domain." The author suggests the possibility that such courseware is inappropriate for certain learning situations and certain learners. Spector makes a strong case for differentiating expertise from knowledge, echoing the doubts raised by a number of theorists from both the cognitive and the constructivist perspectives. He ends by pointing out one major hole in most (if not all) courseware systems: measuring and reacting to learner engagement, which he proposes is a major aspect of learning effectiveness.

Spector complains that a specific courseware product's formalism is inherently reductionistic because it "implies that (the) formalism is adequate for representing all instructional methods and designs." This may be a category error on the part of Spector; there is distinct difference between represented knowledge and a knowledge representation framework. For example, would he be willing to characterize English (or any other natural language) as reductionistic for the same reason? The power of a knowledge representation mechanism is in some ways defined by the breadth and scope of what can be represented within it – for the designers of a representation system to claim that allows for "representing all instructional methods and designs" is simply to claim that it is adequate for the task. This claim may be true or it may not be, but it is not *prima facie* problematic. (21 refs)

Sterman, J. D. (1994) Learning in and about complex systems. *Systems Dynamics Review, 10.* 291-330.

This article is an excellent introduction to the concept of systems dynamics within the context of learning. In the introduction, Sterman declares that "the challenge facing all is how to move from generalizations about accelerated learning and systems thinking to tools and processes that help us understand complexity, design better operating policies, and guide organization- and society-wide learning." The author goes on to describe single feedback loops and multiple feedback loops; the latter allows for changes in the learner's mental models as well as simply allowing the learner to achieve current goals. He explains that "the development of systems thinking is a double-loop learning process in which a reductionist, partial, narrow, short-term view of the world is replaced with a holistic, broad, long-term, dynamic view and then redesign our policies and institutions accordingly." Certain barriers to learning are described, including dynamic complexity, limited information, confounding variables and ambiguity, misperceptions of feedback, flawed cognitive maps and causal relations, and erroneous inferences about

system dynamics. The use of simulations as a necessary aspect of learning is also discussed. For example, if one tries to elicit the knowledge of an expert in order to develop a curriculum, then "regardless of the form of the model or the technique used, the results of the elicitation and mapping process is never more than a set of causal attributions, initial hypotheses about the structure of a system, which must then be tested. Simulation is the only practical way to test these models. The complexity of the cognitive maps produced by an elicitation workshop vastly exceeds our capacity to understand the implications." 118 references.

Strauss, D. (2002) The scope and limitations of von Bertalanffy's systems theory. *South African Journal of Philosophy, 21*(3). 163-179.

This article analyzes system theory from the standpoint of several perennial philosophic questions: (1) the one versus the many (atomism versus holism); (2) the whole-parts relation; (3) constancy versus change; and (4) entelechie or vital force. Of particular interest for this annotated bibliography is the question of the ontological status of a system, that is: does a system exist, or do only the parts of the system exist? For example, a university is made up of people and buildings, but does the university itself *exist* as an entity? If so, in what way? This is similar to Heraclitus's point that one can never step into the same stream twice. From a philosophic standpoint, seeks to determine if systems such as universities, calculus, and pork-belly markets have an independent existence, and what exactly the nature of that existence is.

The author defends a position in between the platonic and the constructivist viewpoints: he disavows the notion of preexisting categories or forms from which particular systems (e.g., universities and labor unions) get their individual existence; however, he also dismisses the constructivist notion that these systems only exist in the minds of the human perceiver. His position is built upon the notion that there are different types of systems including, at least, mathematical, spatial, kinematic, physical and. His point is that any particular system may have aspects of more than one system type, which is why complex systems defy atomization. For example, a cell will certainly have biotic system aspects, but will also have physical (chemical, molecular) and spatial aspects. The article leaves the reader with more questions than answers; however, this may be the nature of philosophic inquiry. 40 references.

Swan, K. (2004). Learning online: A review of current research on issues of interface, teaching presence, and learner characteristics. In *Elements of Quality Online: Into the Mainstream,* J. Bourne and J. Moore (eds.), pp. 63-80. Needham, MA: Slaon Center for OnLine Education (SCOLE).

This article discusses learning effectiveness in asynchronous learning networks. The author begins by noting that using traditional classroom learning as the benchmark may cause us to miss the unique educational qualities of on-line environments. Three types of interaction that affect on-line learning are discussed: interaction with peers, interaction with content, interaction with instructors. Additionally, there is also an interaction with the interface, especially when new technologies are encountered. The author gives an example of how an interface can "push" an interactive discussion thread in one way versus another. Nine principles of interface design and their respective effects are presented, and research is cited demonstrating how design can affect learning. Of

specific interest is a discussion of hierarchical hyperconcept maps and the positive results these seem to facilitate in comparison to linear presentations. The paper continues with a discussion of learner characteristics, particularly what characteristics are likely to make them better or worse candidates for on-line learning. For example, the literature suggests that on-line learning works well for women and mature students, less well for younger males. Culture may also play a role. Finally, the concept of teacher presence (the combined aspects of how the student interacts with the instructor) is discussed. 38 references.

Tait, A. (2000) Planning student support for open and distance learning. *Open Learning, 15*(3). 287- 299.

This article seeks to elaborate six environmental variables in planning for student support in open and distance learning (ODL). Although the abstract states that "these factors interact in complex ways" and indicates that the article will explicate these complex interactions, the article actually only offers a series of fairly obvious observations about the nature and problems of supporting ODL students. While the article would make a good chapter in an introductory text on ODL, it does not seem to add any new insights and/or resolutions to handling the complexity of the interactions. The model given is a very standard "star" shape, wherein one central concept (in this case, student support systems) is surrounded and connected to the six environmental factors of student cohort characteristics, course or program demands, geography, management system, scale, and technological infrastructure. There is no attempt at characterizing the interaction between these aspects of ODL, no use of feedback loops nor any indication how one might actually go about solving particular problems by using this model. 21 references.

von Bertalanffy, L. (1968). The meaning of general system theory. In *General System Theory: Foundations, Development, Applications*. New York: George Braziller.

This article is a general introduction to the meaning and context of general system theory (GST) by the “father” of this theory. Not overly technical, the article seeks to explicate the genesis of the theory and describe its potential benfits to society. The author begins by describing some of the holistic movements in various fields, such as physics (thermodynamics), psychology (Gestalt) and economics (planned economies). Our culture of specialists, he continues, is in need of generalists, but not people who simply know a little about a lot of things – instead, what is needed are people who are well trained in a discipline which allows them to think in higher-level (more abstract) terms than is allowed for in most specialities. These people would be trained in “models, principles, and laws that apply to generalized systems or their subclasses, irrespective of their particular kind, the nature of their component elements, and the relations or 'forces' between them ... a theory, not of systems of a more or less special kind, but of universal principles applying to systems in general” (p. 32).

Yan, Z. The psychology of e-learning: Why, what, and how? In *Elements of Quality Online: Into the Mainstream,* J. Bourne and J. Moore (eds.), pp. 81-92. Needham, MA: Slaon Center for OnLine Education (SCOLE).*?*

This article describes the emerging field of e-learning and compares it to what the author regards as the first two learning systems: speech and paper. The author calls for a systematic study of the aspects of e-learning: psychological factors (e.g., learning style and motivation), processes (e.g., creative thinking and spatial cognition) and mechanisms (e.g., dual-coding and split attention effect). The author then describes in detail the contents of 10 articles to be published as a special issue of The Journal of Educational Computing Research on the subject of the psychology of e-learning. Most of the articles described are oriented toward cognitive psychology, and the author offers several reasons why this might be the case; he does not offer a conclusion, but does state that the cognitive aspect of e-learning is one of the most productive areas of research in the field. Several papers on social processes and developmental issues are then briefly discussed. The paper concludes by calling for both deeper empirical studies and broader interdisciplinary studies. This paper is a good resource for someone looking for a broad-based introduction and good current references to work in this field. 43 references.

Zittle, F. J. (2001). *The Effect of Web Based Concept Mapping on Analogical Transfer.* Dissertation Abstracts International, (62)(11), 3695. (UMI/Proquest Digital Dissertations, AAT 3033980)

This dissertation starts with a discussion of knowledge transfer, especially the failure of teaching methods to facilitate transfer and to demonstrate such transfer empirically. Inert knowledge is knowledge that is relevant to a certain situation but is not used by the student. Spontaneous transfer is an "unmediated mindful abstraction of a prior experience." Measuring transfer requires taking certain theoretical stands which may be problematic. The attitude of the learner may be an important factor in transfer. Schema theory is one theoretical model from psychologists such as Thorndyke and Hayes-Roth; this model may help to explain transfer. Sometimes transfer works, and examples of these situations are given. The amount of prior knowledge of a subject probably effects transfer. Mediated transfer occurs when the student is given various organizational and explanatory devices upon which to base the knowledge transfer. How the information is initially encoded by the learner can have an important effect on whether or not it is used in subsequent relevant situations. The author suggests that how the information is presented will therefore effect the encoding and thus the ability of the student to apply the knowledge to differing scenarios. "Set" can also be a factor, meaning that if students are "primed" to use previous knowledge in order to solve a current problem, they may be more likely to be successful. The author then discusses issues of abstraction and representation.

The paper introduces the idea of concept maps as a representational mechanism. A concept map is based on the notion that mental models consist of a set of objects and their relations to one another. Assimilation theory contends that knowledge is meaningful only when the student is able to associate it with something else which is already known. A number of studies have been performed on concept mapping, and several meta-analyses are referenced. Based on the work of Suen et al, the paper then discusses the notion of "concept mapping as mediated scaffolding." There is a difference between

using concept maps as an organizer versus using them as assessment tools. Sometimes learning how to create concept maps is itself frustrating for the student. A select-and-fill-in (SAFI) map is one in which the student selects terms and concepts from a list in order to generate the map. This is a method of priming the student.

The dissertation goes on to describe original research which was conducted to study the transfer effects of web-based concept maps. The author concludes that the use of a SAFI map is the most effective in generating transfer.

There are a number of epistemological and pedagogical issues with the use of concept mapping as a teaching mechanism which are not addressed in this paper; however, it serves as an excellent overview of the topic. 136 references.