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Reflections on a Post-Gutenberg Epistemology for Video Use in Ill-Structured Domains: Fostering Complex Learning and Cognitive Flexibility

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This is a paper about the underlying epistemic goals and assumptions that structure our approach to using digital video, and the kinds of "video moves" employed in our systems as a result of assuming that epistemic stance. Why we say this epistemology is "Post-Gutenberg" will be addressed at the end.

Our purpose in using video is to promote *deep learning* that results in conceptual mastery and preparation for practice (knowledge application) in *complex and ill-structured domains*. An ill-structured domain is a conceptual arena in which the instances of knowledge application are both individually complex and in irregular relationship to each other – that is, instances that might be called by the same name vary considerably from one to the next. As a result, we argue, it is not possible in such a domain to have a "prepackaged prescription" for how to think and act that covers a wide range of circumstances.[1] Instead, we offer an alternative based on Cognitive Flexibility Theory.

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[1] To see examples of classroom video uses illustrating all of the points made in this paper, write to rspiro@msu.edu for URLs and passwords (which can't be publicly posted because of human subjects requirements). For a non-protected site that shows the interface we use in our classroom video work and *some* of the features of the latter, see EASE History at

To introduce our chapter, we note that our work with video should be situated in the context of the video research of Ricki Goldman (this volume; Goldman-Segall, 1998), Sharon Derry (this volume;), and Maggie Lampert and Deborah Ball (Ball & Lampert, 1998; Lampert, 2001). In many ways, Goldman is the founder of this field of digital video research in education. Her focus on perspective, points of viewing, layering, the constellations metaphor, juxtaposition, children's *thinking attitudes* as seen in online video cases, and configurational validity (Goldman-Segall, 1998), as well as her development of more than five experimental video analysis tools over the past two decades (this volume), continues to lead the way, and certainly finds numerous points of affinity with our own approach.

Features of Complex Learning in Cognitive Flexibility Theory and Associated Video Strategies

What more can be done for *learning* with digital video cases to promote deeper and more applicable knowledge? This chapter has a particular and very limited focus: the special kind of *learning* that video affords if one pushes beyond showing video, cataloguing it, and talking about it. We offer a *concise* statement of our philosophy of teaching for complex learning with digital video. That philosophy has two parts: (1) an underlying ontology of ill-structuredness (i.e., domains of knowledge and practice that are in their very nature, as they occur in the world,

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http://www.easehistory.org, which has as its focus 20th century American history, with an emphasis on the history of presidential campaign ads (Collins, Spiro, Ramchandran, & Ruggiero, in preparation).

characterized by indeterminacy, change, resistance to global generalizations, and so on); and (2) a theory of learning, instruction and mental representation, Cognitive Flexibility Theory (*CFT*), whose features are determined by the ontology of ill-structuredness and that in turn guides the development of hypermedia learning environments (e.g., Spiro, Coulson, Feltovich, & Anderson, 1988; Spiro & Jehng, 1990; Spiro, Collins, Thota, & Feltovich, 2003). How this ontology determines the features of CFT that in turn determine the kinds of video moves we make in our learning systems is the focus of discussion in the sections that follow. It is a truism, we think, that what you do with video is not as important as *why you do it*. This paper is about our "why."

Why Video?

If the goal is presenting complexity as it naturally occurs in order that learners may acquire knowledge of that complexity, then video is obviously a big step forward. Can video present full complexity? Obviously not. Can a fuller presentation of complexity be *approximated*? Yes. Is one camera angle too limiting? Add another. Still to limiting? Add more. Provide auxiliary material not captured on video. Add commentaries from different perspectives. And so on. Will you have fully portrayed the complex reality? Again, no – but you will have gotten a lot closer. Shoot for better approximations to the fullness you need for future knowledge application, and don't worry too much that you'll never get all the way there. It's still a lot more than we had before. (By the way, it should be understood throughout this paper that we always intend for our video systems to be used in the context of some ecologically valid learning purpose or task.)

Changing Underlying Habits of Mind: Prefiguring Complexity and Opening Perception

We have identified over the years a tendency toward oversimplification we have called the *Reductive Worldview* (Feltovich, Spiro, & Coulson, 1989; Feltovich, Coulson, & Spiro, 2001; Spiro, Feltovich, & Coulson, 1996). Video affords many ways to combat these habits of mind and replace them with an alternative more suitable to dealing with complexity. Learners need to be predisposed to say "It depends," and "It's not that simple." In our video presentations, we do things like literally having the screen startlingly disintegrate into what look like glass shards at points where we know there is a tendency to think what is being viewed is straightforward, obvious, predictable. A loud voice boom something like "It's not that simple, look again," at which point scenes are re-viewed with special-effects overlays that highlight what was missed on the first viewing. It is not long before learners start to automatically question their pat assumptions and begin to habitually look harder, look again, expect to see more. Habits of mind are hard to change. Video affords ways to catch people's eye and call attention to the often unconscious assumptions they are making.

Opening Knowledge Structures: Conceptual Variability Demonstrations

The goal in CFT systems is to produce open and flexible knowledge structures to think with in context, not closed structures that tell you what to think across contexts. Thus one of the first things we do with video examples that have been conceptually categorized is to show many variants from the same category. The purpose is to demonstrate that category members in ill-structured domains bear only a family resemblance to each other, kind of similar and kind of different. There are no core defining characteristics, so the meaning is in the patterns of real-

world *use* (Wittgenstein, 1953). Learners with our systems quickly see variability in conceptual application across different video clips as *basic* to understanding those ill-structured concepts.

So, for example, in one CFT-based video system (Palincsar, Spiro, Kucan, Magnusson, Collins, Hapgood, Ramchandran, & DeFrance, in press) to teach reading comprehension strategies, the thematic concept of *scaffolding* would be taught by first having the learners look at a large number of examples of scaffolding in instruction. They then come to see that scaffolding is a very complex concept for which they can not prepackage a definition that would adequately guide use. And they also see demonstrations of the rich variety of contextual features that affect how the concept is applied.

One of our interface features, the "Weave" mode (which allows four video clips to be compared in simultaneously appearing quadrants – this feature can be seen in EASE History, at the URL provided earlier), permits a certain kind of exercise that is useful for helping people to understand the ill-structured character of such conceptual families. We ask people to use the Weave interface to set up four clips that belong to the same conceptual category and then to identify *surprising similarities* (clips that don't appear similar on the surface but on closer inspection can be seen to be instances of the same concept) and *surprising differences* (aspects of clips that seem similar on the surface but that are different in interesting ways when viewed more closely). Learners are quickly dissuaded from reductive notions of meaning and concept-use; and a richer sense of meaning for the particular concepts is provided.

Generally, we find that four-way comparisons using the Weave quadrant interface have many features that permit subtleties of similarity and difference to emerge that would not in standard two-way comparisons. ("In what ways are A and B similar, but different from C, while A and D have similarities that B and D don't…." – although clips A, B, C, and D are all similarly

categorized.) See Spiro, Collins, and Ramchandran (in press) for a discussion of other ways that CFT-based video learning environments promote openness in conceptual representations.

Learn from Cases, See Lots of Cases, and See Cases Multiple Times in Different Contexts: Revisiting Is Not Repeating

In an ill-structured domain, wide-scope generalization is not possible - in principle (that's what makes it an ill-structured domain). In the absence of general principles or schemas to guide knowledge application, transfer depends on having a rich store of experiences that capture the variety of ways events in a domain happen and the ways concepts of a domain combine. Rather than acquiring knowledge from examples (as in well-structured domains), the knowledge is *in the examples*.

So we don't just show one video as an exemplar case, we always show *a lot* of video cases. And we don't just show each case once, we show it more than once, in different contexts, so as to bring out alternative facets of its complexity. When one criss-crosses landscapes of knowledge in many directions (the main instructional metaphor of CFT, drawn from Wittgenstein; Spiro et al., 1988), *a revisiting is not a repeating*. The result is knowledge representations whose strength is determined not by a single conceptual thread running through all or most parts of the domain's representation, but rather from the overlapping of many shorter conceptual "fibers" (Wittgenstein, 1953), as befits an ill-structured domain. (This re-use of complex video clips will come up again later, in the section on Experience Acceleration.)

Conceptual Combinations and Knowledge Assembly

Of course, our systems have thematic coding of clips so that they may be retrieved in various ways. However, one important feature of our multiple codings of individual clips is that multiple theme searches are possible. This permits a kind of *combinatorial idea play*. The further you go in developing hypotheses about a domain, the richer the kinds of search for video evidence you can undertake, allowing the testing against video data of increasingly complex conceptual hypotheses.

This use of conceptual combination searches also instills the idea that a clip is not just an example of one kind of thing. Rather, concepts combine in context in ways they often do not do in concept=based organizations of textbooks. And, of course, learning the patterns of concept combination in context, and how each concept in turn serves as a context for each other, is an important lesson about ill-structured domains.

Crossroads Cases: Clip-Selection to Maximize Transfer

If the main metaphor in CFT is "criss-crossing a landscape" of knowledge, one of the best ways to engage that process is by investing at first in cases that have many lessons to teach. Such rich cases, at the "crossroads" of the landscape, teach many lessons with relatively small cognitive investment (because the clips are short, usually anywhere from a half-minute to a few minutes in length). In a sense they are partial *microcosms* of the landscape as a whole. A major goal of CFT is to teach *complexity*, but to do it in a *cognitively tractable* way. These crossroads micro-cases are "bite-size chunks" of manageable processing size that don't strip away the features that make for complex ways of thinking. For example, one can promote seeing *multiplicity* with a

small, manageable multiple (which is still enough to discourage the reductive bias of seeing a single "answer" in things, a single best way of looking or thinking).

Thus by using these dense, representative short videos, these *crossroads cases*, the often *antagonistic* goals of presenting complexity and making learning cognitively manageable are simultaneously achieved. This mode of instruction is *synecdochal*, in that it shows the whole in the part. It allows a view of a "world in a grain of sand"

Accelerating Experience

It takes way too long to become an expert practitioner of anything that matters, whether it's being a teacher, a doctor, or an engineer. We've all heard of the "Ten Year Rule" for attaining expertise. One reason so much experience is needed is because instances of knowledge application take so many forms in ill-structured domains of real-world practice. A fundamental goal of video use in CFT-based systems is to accelerate the process of familiarizing learners with many of these forms (and the connections among them) in a much shorter amount of time, within the span of instructional contact.

This experience acceleration happens in a variety of ways in our systems. One way is by capitalizing on the previously discussed principle of providing repeated viewings of complex clips. This would be important to do in any case because you could not see their full complexity in a single viewing from a single contextual perspective. However, there is the additional benefit that once you have seen a clip that is a few minutes long two or three times, you become quite familiar with the particulars of that event. Once a learner has made that investment in a rich, crossroads case, no more than a few seconds of it needs to be seen in order to be reminded of the rest.

Once this stage is reached we can have people making dozens of informative comparisons and contrasts in an interface that permits a large number of clips to be bounced off of each other in a short span of time. It would take more than seven minutes to contrast a four-minute and a three-minute clip. In our approach, by comparing overlearned, highly familiar clips presented in seconds, one can make a huge number of comparisons in that same seven-minute amount of time. The learner is reminded of the rest of the familiar clip by the brief "distinctive highlight," and the non-presented content "comes along for the ride" in connecting to non-presented content in other abbreviated clips. And the more connections you make, the more *cognitive momentum* you build up, further accelerating the experience acquisition process. The learner becomes like a conductor, orchestrating the rapid bouncing of clip off of clip, permitting the noticing of connections that might not have been noticed otherwise, and rapidly building a supported and sustainable web of overlapping representations that in turn forms a basis for situation-sensitive knowledge assembly in the future. And preparation for knowledge assembly is the key if your knowledge can not be precompiled for use (see also Bransford & Schwartz, 2000, Hatano & Inagaki, 1986). In CFT, we prepare people to put together a "schema of the moment" out of fragments of the past to suit the needs of the present. At its epistemological core, *everything* in CFT revolves around this goal.

Post-Gutenberg?

Let's look at an example. We just wrote of learners being conductors (or jazz improvisers), rapidly bouncing excerpts from rich video clips off of each other. Those of us who are a bit older feel a little strange contemplating this (though we have found that adults have no trouble learning to do it). But there is a younger generation, raised on MTV, video games, television

ads, and the Web, who have been doing it their whole lives. And for them it's more natural than a lecture or a book. So why not capitalize on their affinity for this mode of "quick-cutting" across dense images (cf. Stephens, 1998) – and their accustomedness to nonlinear processing generally – for *teaching*, and to promote more complex and flexible learning? Pack video with important content as it naturally occurs in real-world events. Build in overlays to help manage conceptual and perceptual complexity, and to adjust habits of mind, re-present the video in new contexts to teach the richness of events, but also to make those clips very familiar. And then capitalize on that familiarity to criss-cross between many video excerpts to speed up and deepen the process of building interconnected knowledge from experience (again, always in the context of some authentic task or purpose).

This example does not look like the kind of learning and teaching that goes on from any traditional epistemological base. And I would argue that the same goes for the other aspects of CFT that infuse our use of video, as we have presented in this chapter. That is because this kind of instruction could not happen without digital media and their random access capabilities. The new media *are* making possible a new kind of nonlinear and multidimensional learning.

And that is why we say this epistemology is a Post-Gutenberg one. It is an entirely different mindset from the ground up, *prefiguring* thought (and knowledge) in an entirely new way. Just as language and story changed the species, and then Gutenberg's printing press and the widespread availability of text fundamentally changed how we think, digital epistemologies (perhaps like the one offered here to undergird video use and other kinds of learning) will alter the very nature of what it means to think, to learn, to teach, to see (Spiro, 2006a,b).

The world is what we are trying to understand, and there is very little that is linear about the world. This kind of technology-based, Post-Gutenberg nonlinearity allows learning to follow

the contours of the world –and, paraphrasing McLuhan, the medium to embody a new cognitive message.

Language, story, text – the successive achievements of the species won't be left behind. But they will be assimilated into a new way of thinking that digital technologies are making possible -- and that our ever more complex and rapidly changing world of life, work, and study so urgently needs.

We have highlighted some of the main epistemological underpinnings of learning systems based on Cognitive Flexibility Theory and the kinds of video moves that are associated with those foundations. So why did we call this a "Post-Gutenberg Epistemology"? Because these new media are digital. And that makes a kind of *nonlinearity* and *multidimensionality* possible that could not be achieved with traditional linear media, refiguring thought from the ground up (Spiro, 2006).

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