New Technology for Empowering Virtual Communities

David Lebow
HyLighter, Inc., USA

Dale Lick
Florida State University, USA

Hope Hartman
City College of New York, USA

INTRODUCTION

In an essay entitled, *The Next Information Revolution*, Peter Drucker (1997) compared the existing business environment to conditions in the sixteenth century within the emerging publishing industry. Up until the mid 1500s, the people who controlled the industry were skilled printer craftsmen. By the end of the century, a major shift had occurred as publishers replaced craftsmen as the industry leaders. What had happened, according to Drucker, was that the focus shifted from the "T" in IT to the "I." Drawing an analogy to the present, Drucker suggested that the current information revolution will have a transformational effect on society only when new technology realizes its potential impact on the *meaning* of information.

This article describes a hybrid social software and hypermedia authoring system, referred to as *HyLighter*, which may fit Drucker's definition of transformational technology. *Social software* (also referred to as social networking software) is a broad category of Internet applications for connecting individuals and forming virtual communities using various forms of computer-mediated communication. *Hypermedia* refers to a computer environment in which multiple linkages enable users to navigate from one segment of audio, video, graphic, or textual data to another segment. HyLighter builds on the affordances of these and related technologies to extend the capacity of the document as a medium for the social construction of *meaning*. In the process, HyLighter aims to improve individual and group performance in a wide range of domains and interdisciplinary problem areas, improve the quality of instruction, and develop proficient learners (i.e., strategic, self-regulated learners who know how, when, and where to apply appropriate learning activities across various content areas) (Hartman, 2001).

This article also describes an advanced adaptation of HyLighter, referred to as *Coalesce*, which is currently under development. When fully realized, Coalesce will help users merge ideas together from many sources into a unified whole that expresses a new perspective. The process identifies important ideas in multiple texts and exposes a range of views on selected points among a group of users. It also coordinates group activities in organizing and elaborating on the ideas of authors and readers toward achieving a cohesive, meaningful whole. In sum, HyLighter emphasizes responding to a document and social analysis whereas Coalese empasizes the social construction of a new document through social analysis and synthesis. Such new and emerging technologies supports a type of knowledge-building process aimed at empowering virtual communities engaged in knowledge intensive enterprises in a world awash with information.

OVERVIEW OF SOCIAL ANNOTATION PRACTICES

During the Middle Ages, scholars used the margins and spaces between lines of manuscripts to engage in dialogue with other readers. The same physical copy of a manuscript was passed around a community, and selected annotations were customarily retained when scribes made new copies (Wahlstrom & Scruton, 1997). With the arrival of the printing press and movable type in the fifteenth century, the printed word became the

primary means for the spread of ideas and ideologies. As Gutenberg's invention revolutionized the spread of information, shared or social annotation practices largely faded away. The role of *reader as co-author and member of a community engaged in a collaborative search for meaning* generally changed to a largely private activity. At the same time, annotation practices became more personal, idiosyncratic, and ubiquitous, as demonstrated by Marshall's (1998) analysis of used textbooks from a college bookstore.

With the arrival of the computer and networking technologies, the storehouse of human knowledge began to expand rapidly and move from largely printed matter toward largely text-based digital archives (e.g., Google Print, 2004), and increasingly toward multimedia digital archives (e.g., Artstor, 2004). At the same time, social annotation practices re-emerged as various forms of social annotation systems spread across the digital landscape. Today, a wide variety of tools and systems exist that allow users to annotate Web-based or other data via the Web or other Internet protocol for various purposes (e.g., the product review feature in *Amazon.com* and the seller rating feature in *ebay* are, essentially, annotation tools).

Annotation is most commonly understood as adding emphasis (e.g., underlining, highlighting, special markings) or critical or explanatory notes to a text. Within the diverse professional communities that work with information systems and resources, annotation covers a much wider territory and is a much fuzzier concept. Essentially, annotation is viewed as unstructured *metadata* (i.e., data about data), which is added after the creation or capture of the original object and, generally leaves the original object unchanged. It is unstructured in the sense that annotation, like text in general, does not conform to a predictable structure (Gilliland-Swetland, 2000; Shabajee & Reynolds, 2003).

On the most general level, social annotation systems differ in who can add annotations to objects in the system and who can read the annotations (e.g., personal use only, shared among members of a team or community of practice, or widely available for public/social purposes). Considering basic functions, social annotation systems create annotation objects (usually text-based, but can be audio or pictorial) with certain attributes, including content, author, date-time stamp, URL of the annotated information object (usually a document but, increasingly, audio, graphic, or video files) and information about placement of the annotations.

Brown and Duguid (1996) pointed out that documents not only deliver information but also build and maintain social groups. From their perspective, the document is a medium for the negotiation of meaning, and, on this basis, they have recommended developing technology to improve the means of negotiation. Technology for collaborative or social annotation appears to be the kind of technology that Brown and Duguid have advocated. In order to realize the full value of social annotation, systems are required that users can easily adapt to various contexts of use and requirements of different epistemic cultures, that is, "those amalgams of arrangements and mechanisms … which, in a given field, make up how we know what we know" (Cetina, 1999, p.1). At this time, however, what we understand about how to implement and manage social annotation systems to empower virtual communities is mostly uncharted territory.

THE HyLighter SYSTEM

HyLighter is a synthesis of hypermedia authoring, social annotation, and related applications functioning within a browser-based network. The design of HyLighter embodies certain conjectures about learning and teamwork drawn from the existing research and theory base of the learning sciences. The technology supports collaboration and coordination of group processes through unique visualization and collaboration capabilities. Although HyLighter has certain features and functions in common with other kinds of collaborative and social software (e.g., electronic communication and conferencing tools, collaborative management and writing systems, blogs, and wikis), HyLighter supports learning communities and document-centered work groups in a number of unique ways.

HyLighter has the capacity to merge annotations from multiple readers for a single document or multiple documents and represent composite displays of the *collective annotation* of a group. The system provides an array of tools for (a) structuring and managing digital conversations and other forms of asynchronous and synchronous modes of interactions within and across documents (e.g., Word, PDF, html, image files and, eventually, audio and video files) and (b) enhancing such documents by adding annotations to documents for eliciting responses from project members and linking to related text, graphic, sound, animation, or video

files. A project administrator/author applies HyLighter's capabilities to prepare a document or a set of interlinked documents, referred to as a portfolio. After this authoring step is completed, the project administrator has an assortment of features available for managing social annotation practices and processes to achieve desirable outcomes.

Compare Feature

Once a group annotates a document, HyLighter merges annotations from all or selected members and represents composite displays of the group's collective annotation (i.e., highlighted excerpts linked to comments) as color-coded "maps" and customizable tables. Users may apply HyLighter's display features for analyzing and organizing highlighting and comments for a wide range of purposes (e.g., exposing multiple perspectives, building consensus, and assessing understanding and competency).

HyLighter's capabilities for displaying shared annotations include provisions to (a) compare *hylights* (i.e., highlighted sections of a text or image and related comments) of a selected individual to all or selected others using color-coding or other forms of emphasis, (b) compare general comments (i.e., general comments or summarizations related to the document as a whole) of a selected individual to all or selected others, (c) view responses to the comments of other reader/annotators, referred to as threaded comments, and (d) display the annotation of a group in various table formats. HyLighter uses color-coding to create a cumulative "map" of multiple readers' "intellectual travels" through a document and, additionally, to single out an individual's journey and compare it with the whole or with the paths of the most experienced travelers.

Once group members have annotated a document, a user may see a merged, color-coded view of a group's highlighting by clicking the *Compare* icon. For example, as illustrated in Figure 1, a text fragment (or area of an image) highlighted by the logged-in user but not by anyone else in a group, appears in yellow; excerpts *not* highlighted by the user, but marked by one or more group members, appear in shades of blue (the darker the shade, the greater response frequency for that fragment); and excerpts highlighted by the user and one or more group members appear in various shades of green (the darker the shade, the greater response frequency for that fragment). Clicking on a highlighted area displays all comments linked to the selected area.

Threaded Comments

HyLighter provides a simple mechanism for users to make threaded comments. When participants are viewing comments of others, they may click on a special icon next to a selected comment and enter a response to the selected comment. The threaded comment may be designated as "open" (i.e., anyone in the group may view it), "private" (only available to selected users and the person who authored it), or "anonymous."

Table Format

Clicking the *Table* icon in HyLighter reorganizes highlighted text and associated comments into a customizable table format. The table presents the collective annotation of a group or selected readers for a single document (or, in the future, many documents taken together) in a format that facilitates sharing, assessing, and manipulating results. HyLighter's table adds value to the collective annotation of a group in a variety of

Figure 1. HyLighter version 3.0 color-coded display

ways, including (a) effectively reveals convergence and divergence of highlighting and comments among members of a group, (b) supports the analysis of multiple responses to a document, (c) enables users to compare group data to data collected from one individual or subgroup of individuals, (d) facilitates an understanding or analysis of one or more documents, (e) provides a convenient editing and collaborative writing method through an online editor with provisions for version control, and (f) provides a variety of methods and instruments to assess/measure performance of contributors or evaluate the quality of a target document.

Permission Table

The permission table enables the Project Administrator (PA) to control social annotation processes in order to support defined objectives and outcomes. How the PA sets current and future permissions in the life of a social annotation activity determines when participants can add annotation to a document and share their annotation with others. For example, an editor recruits three reviewers to participate in a peer review process supported by HyLighter. The editor sets permissions for the manuscript to initially allow reviewers to add hylights and general comments but not view each other's annotations. The editor sets permissions to change in a week to restrict reviewers from adding or changing their annotations but allow reviewers to compare their annotations to their peers and add threaded comments (i.e., comments on each other's comments). Through this mechanism, the editor or PA can control and shape the social annotation process to match the requirements of the context of use and desired outcomes.

Coalesce

As mentioned previously, Coalesce is an advanced adaptation of HyLighter for helping a group merge ideas together from many sources into a new and unified whole. Coalesce treats each idea in a digital document like a part in an erector set which can be used and reused in any number of constructions. Although some of the features described below are under development (e.g., labels and multidocument table functions), Coalesce promises an enhanced approach to document-centered group work that extends the capacity of documents to promote collaborative knowledge-building in the face of expanding sources of information.

In brief, the Coalesce process requires team members to use HyLighter in order to produce a project collection or anthology of benchmark documents. A *HyLighter benchmark* is an annotated view of a document representing the collective thinking of a group of informed readers. One method used to produce a benchmark includes the following steps:

- A project leader or PA selects a set of related documents for review, assembles a representative group of qualified readers, and prepares the documents.
- **Round one:** Group members read a selected document and use HyLighter to add hylights and general comments, consistent with the task perspective statement. Participants classify each highlighted section and related comment by adding a label or short descriptor.
- **Round two:** Participants reconsider their own annotations compared to the annotations of their team members. Participants add or delete highlighting, revise comments, revise labels, and add threaded comments.
- **Round three:** The PA reviews the collective annotation of the group in *Table Format* and makes revisions toward representing a concise and representative view of the group's multiple perspectives (i.e., a benchmark view). The table displays each paragraph in the selected document with linked comments below each paragraph (i.e., paragraph one followed by comments linked to paragraph one, paragraph two followed by comments linked to paragraph two, etc.). General comments appear in a separate table.

Once the group has completed the benchmarking process for a set of documents, the PA opens all benchmark documents in *Table Format*. The program has provisions for resorting hylights and general comments in different ways including by contributor, by tags (i.e., labels appended to highlighted sections of text), and by flavors (i.e., labels appended to comments). For example, all the comments labeled as questions by contributors and related excerpts can be aggregated for review. Alternatively, all highlighted sections labeled with different concept terms and phrases can be aggregated by tags. This capacity to reorganize the *idea units* from a large set of interlinked and collectively annotated

documents provides participants with a bird's eye view of the thinking of multiple authors and readers.

The Coalesce process continues as participants rearrange and add to this medley or composition through analysis, synthesis, and judgment. As team members create a new order of excerpts and notes, the process reveals areas requiring further inquiry and elaboration. Deeper reflection suggests new associations among important ideas, and, eventually points to new patterns and insights. The process continues through several iterations until a breakthrough in understanding occurs and important issues are adequately addressed.

Coalesce provides a type of deliberate practice that both improves results (effects with) and develops skills (effects of) (Salomon, Perkins, & Globerson, 1991). The process is enhanced as team members with common goals share multiple perspectives and provide each other with a supportive social context for reflection and feedback. The result is that the domain knowledge of participants increases, ideas become more interconnected, ability to think within the target area becomes more expert-like, and the team becomes more capable of supporting the knowledge-building enterprise (Berieter & Scardamalia, 1993).

FUTURE TRENDS

HyLighter is a tool for building greater individual and group capacity, collaboratively actualizing collective intelligence, and enhancing meaning and usefulness. Currently, a number of initiatives are underway to investigate the use of HyLighter for a range of purposes including, among others, (a) improve critical reading and expository writing skills in second-semester college English, (b) improve mathematics problem solving skills in introductory algebra, (c) provide Forensic Science instructors with an authoring environment for creating authentic learning and assessment activities, (d) provide data with implications for revising curriculum and/or instruction, and (e) support interdisciplinary work among a diverse group of experts involved in the development of end-of-life treatment guidelines.

In addition to the above, efforts are underway across various HyLighter initiatives to develop alternative forms of assessment. The lack of procedures that are easy to administer and provide diagnostic information for assessment of complex cognitive skill development is a major obstacle to widespread adoption of more learning-centered approaches to instruction. Development work which builds on the HyLighter system to address this issue include, for example, (a) the *interactive annotation performance* (IAP) instrument which provides a quantitative measurement of students' performance in carrying out assigned annotation activities, (b) 3D concept maps with links to annotated documents, graphics, and video clips for synthesizing the "big picture" of a course or problem area, individually or collaboratively, and (c) explanatory multiple choice tests where learners compare their answers and explanations with a model, analyze their errors, self-correct, identify error patterns, and plan for future improved performance.

CONCLUSION

Today, a number of technologies, which reside at the interface between people and the rapidly expanding digital universe, have the potential to trigger major changes in document-centered group work and the way people learn. This article described one such technology, including the historical background and theoretical assumptions underlying its design and use. In sum, when guided by principles from the learning sciences, HyLighter facilitates the mutual and productive influences of people, objects, and events on one another through three key affordances:

1. Makes thinking that is ordinarily hidden become transparent and available for self-reflection, sharing, and feedback.
2. Allows users to continuously compare their developing understanding to others, assess performance, and monitor progress.
3. Supports efforts to organize, integrate, and synthesize ideas from multiple sources and perspectives.

In the future, evaluation studies, design-based research, and quasi-experimental studies will help refine this emerging technology and reveal what additional capabilities are necessary to match the HyLighter system to various contexts of use and different epistemic cultures.

REFERENCES

Artstor. (2004). Retrieved March 27, 2007, from http://www.artstor.org/info/

Bereiter, C., & Scardamalia, M. (1993). *Surpassing ourselves: An inquiry into the nature and implications of expertise*. Chicago, IL: Open Court.

Brown, J.S., & Duguid, P. (1996). *The social life of documents*. First Monday, 1. Retrieved March 27, 2007, from firstmonday.org/issues/issue1/documents

Drucker, P.F. (1997). *The next information revolution*. Retrieved March 27, 2007, from http://www.versaggi.net/ecommerce/articles/drucker-inforevolt.htm

Gilliland-Swetland, A.J. (2000). *Introduction to metadata: Pathways to digital information*. Retrieved March 27, 2007, from http://www.slis.kent.edu/~mzeng/metadata/Gilland.pdf

Google Print. (2004). Retrieved March 27, 2007, from http://print.google.com/googleprint/about.html

Hartman, H. J. (2001). Teaching metacognitively. In H.J. Hartman (Ed.), *Metacognition in learning and instruction: Theory, research, and practice* (pp. 149-169). The Netherlands: Kluwer.

Knorr, C., & Karin, D. (1999). *Epistemic cultures*. How the sciences make knowledge. Cambridge: Harvard University Press.

Marshall, C.C. (1998, June 20-24). Toward an ecology of hypertext annotation. In *Proceedings of the ACM Hypertext '98* (pp. 40-49), Pittsburgh, PA.

Salomon, G., Perkins, D.N., & Globerson, T. (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher, 20*(3), 2-9.

Shabajee, P., & Reynolds, D. (2003). *What is annotation?* A short review of annotation and annotation systems. Retrieved March 27, 2007, from http://www.ilrt.bris.ac.uk/publications/researchreport/rr1053/report_html?ilrtyear=2003

Wahlstrom, B., & Scruton, C. (1997). Constructing texts/understanding texts: Lessons from antiquity and the Middle Ages. *Computers and Composition, 14*(3), 311-328.

KEY TERMS

Collective Intelligence: A richly diverse area of study and practice with many uses appearing in the literature. In the current context, collective intelligence refers to the capability of a group to share thought processes and synthesize collective output in ways that amplify and improve outcomes.

Epistemic Cultures: Are "those amalgams of arrangements and mechanisms…which, in a given field, make up how we know what we know" (Cetina, 1999, p.1).

Hypermedia: Refers to a computer environment in which multiple linkages enable users to navigate from one segment of audio, video, graphic, or textual data to another, related segment of data.

Interdisciplinarity: Has many definitions and related concepts and meanings (e.g., multidisciplinarity and transdisciplinarity). In this context, interdisciplinarity is defined as a problem-based approach in which knowledge and methods from more than one discipline are applied as needed to solve a complex problem.

Online Annotation Systems: Enable users to add metadata (i.e., data or information about information) to a Web resource or other online resource without actually modifying the resource itself. Many different online annotation systems exist across the Web for a wide range of purposes.

Social Annotation: Online-annotation (i.e., *metadata* or data about data) associated with a Web resource, typically Web pages, and shared by a group. The annotations can be thought of as a layer on top of the existing resource which is added after the creation or capture of the original object and, generally leaves the original object unchanged.

Social Software: (also referred to as social networking software) is a broad category of Internet applications for connecting individuals and forming virtual communities using various forms of computer-mediated communication.

Virtual Communities: Are groups of people who share common interests, ideas, and feelings, and whose members are connected by means of information technologies, typically the Internet. Similar terms include online community and mediated community.