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ABSTRACT

"Cognoter(tm)" and "CB" software, two new computer-based writing tools that rely on shared texts and real-time communication among participants and support collaborative invention, have implications for invention pedagogy and research. Cognoter improves on current invention aids by combining a brainstorming tool, a graphical linking tool, and an outlining tool. An aid designed for use by groups to further the collaborative development of presentations, Cognoter can also suggest new heuristics that might become the basis for invention aids. While not explicitly oriented to supporting inventional activities, CB software essentially allows users to send each other messages in real time via a network. CB's social, conversation-based approach offers several potential benefits for invention pedagogy: (1) it provides a naturalistic setting for introducing formalized heuristics; (2) with the teachers online, the use of more advanced techniques can be demonstrated in context; and (3) new heuristics could grow out of online conversations. Collaborative tools such as Cognoter and CB may make inventional activities more explicit, and may also reveal that the inventional behavior of groups is different from that of an individual. However, researchers must be careful in interpreting the large body of data generated by these collaborative invention tools. (JD)

Invention Aids for Computer-based Writing: Expanding the Horizons through Collaborative Invention

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Abstract

A new emphasis on tools to support collaborative invention is proposed and explored. Two tools that support collaboration are examined, Cognoter(tm) from Xerox PARC and the "CB" software used in the ENFI(tm) projects at Gallaudet University and elsewhere. Implications of these tools for invention pedagogy and research are presented.

Invention Aids for Computer-based Writing:
Expanding the Horizons through Collaborative Invention

We have many options as we consider how best to expand the horizons of computer aids to invention, some based on new technologies and some on new findings from research. However, I wanted this talk to be more than a report on new gizmos or an impenetrable discussion of theory, so I set out to find an invention aids topic that would satisfy the following criteria:

1. Broad scope--so that it will support both research and development (both theory and tools);
2. Depth of theoretical interest--so that it will survive whatever effort we spend "technology hopping" as we look for the latest and greatest gadgets; and
3. Approachability--so we can start on it now instead of waiting for "pie in the sky" technological or research developments.

Those are demanding requirements, but I believe that I have found a topic which satisfies all of them, so I have renamed my paper slightly to be "Expanding the Horizons through Collaborative Invention."

Before I start, I want acknowledge my debt in this paper to my collaborator, Trent Batson of Gallaudet University. Trent and I have been working together for several months on research projects concerning collaborative invention, so some of the points I'm making here grow out of a shared context that we have established.

Collaborative invention?

Your first reaction on hearing my new title may be to wonder whether the term "collaborative invention" is an oxymoron. It is if we limit our notion of invention to the "one person, one text" view which underlies many of our invention aids. However, by now we all know from the socio-cultural theorists in our midst that other people have broader influences on how we think and create texts than our "lone wolf" model of invention usually

accommodates. However, it is not always clear from reading such theorists how to get from a general understanding that others are important in invention to computer tools which can support group-oriented inventional activities.

Two computer tools exist which can help us bridge that gap. One of them, a tool called Cognoter(tm) produced at Xerox PARC, is recognizably an invention aid for use by groups (Stefik, et al, 1987). The second, the "CB" software used in the ENFI projects (Batson, forthcoming), is less obviously an invention aid, but nonetheless can take a place among inventional tools once we expand the horizons a bit. Today I am going to explore the implications for inventional pedagogy and theory of these two tools, each of which relies on shared texts and real-time communication among participants. I believe that they and products like them may transform our understanding of invention as well as how we teach it.

Cognoter

Cognoter is a tool that looks like several typical invention aids put together and made useable by groups. It was designed to support the collaborative development of presentations. Participants in a Cognoter session sit at a group of networked workstations and work simultaneously. An individual's screen contains a large shared area in which any user in the session can type or draw lines, along with one or more private windows in which side-conversations or small texts may be in progress.

Cognoter supports two basic activities: contributing ideas to a group brainstorming session and linking the ideas into groups. Users add items, usually words or short phrases, to the shared area during brainstorming and no one is allowed to delete items. A user may annotate an item with an explanation or extra details; items with annotations are marked with boldface type. Individuals may read the annotations without forcing the entire group to view them. Finally, items are grouped by drawing lines among them. Arrows indicate the sequential relationships. The lines are easy to erase and redraw, making relationships easy to adjust as the group settles on the content and organization of their presentation.

Because it supports the two general activities of brainstorming and grouping ideas, in some sense Cognoter deserves the description that one of its creators gave in a talk: "a fancy idea processor" (Foster and Stefik, 1986). Some writing teachers have charged that idea processors are not appropriate for use as invention aids because their emphasis on outlining reinforces an outmoded pedagogy. However, Stefik and his colleagues note that Cognoter solves the problem of strict hierarchical outlines; its graphical interface permits more flexible groupings of items (1987, 37). Cognoter also allows groups to put off the formulation of an outline until the participants agree on an overall structure. Hence, observations of people using Cognoter suggest that idea processors may be more valuable as invention aids than critics have believed, at least in group settings.

Cognoter represents an additional improvement over our current invention aids by the way it interlinks a number of what we have heretofore regarded as separate aids. By combining three tools into one--a brainstorming tool, a graphical linking tool, and an outlining tool--and thereby ensuring that each tool works on the same shared information, Cognoter supports the kind of recursive movement among generating, grouping, outlining, and editing which we often find pedogogically desirable but almost impossible to achieve in practice.

Cognoter can also suggest new heuristics that might become the basis for invention aids. For example, in their book *The Network Nation*, Rozanne Hiltz and Murray Turoff discuss a technique called "brainwriting" in which each person writes his or her ideas on separate pieces of paper during a brainstorming session and then circulates them to the other group members (Hiltz & Turoff, 1978, 301). Each member is asked to comment on each idea; then all the papers are gathered and summarized by the group moderator. Collaborative texts produced by "brainwriting" in the classroom might become the springboard for either a collective text like a report or a number of different texts by individuals. Having such texts available in electronic form would make it easy for individuals to choose the parts of interest to them. Such an exercise is similar to peer review

techniques in which whole papers are exchanged, but the grain size is smaller (a couple of sentences rather than a whole paper) so more class members can comment. In addition, the ideas are not as close to final form as they might be in a complete draft, so students may be more likely to make changes as a result of the group activity.

CB and ENFI

While Cognoter is clearly an invention aid and even contains subparts that we recognize, the software used in the ENFI projects, a package called "CB," is not explicitly oriented to supporting inventional activities. It contains no prewriting exercises, no tools for linking ideas or outlining, and no built-in notion of invention as a separate "stage" of the writing process. Essentially, users of the CB software send each other messages in real time via a network. Each user's screen contains a shared area in which messages appear in a kind of ongoing chatter and a private area where users compose messages to send. Users are encouraged by the rapid pace of the exchange to keep individual messages short and to follow the flow of the online discussion.

The model for CB is neither "the writing process" with its component parts nor some notion of "group process" such as is often embodied in computer-based productivity tools. Instead, the model is conversation. Although we use conversation as an inventional heuristic constantly and encourage students to do so via conferences and peer-tutoring sessions, conversation has not figured prominently in our inventional theories. As Karen Lefevre notes in her 1984 dissertation, we could perhaps connect conversation as a heuristic to one existing notion, the idea that "inner dialogues" can be a source of invention which appears in a few theorists such as Don Murray and Peter Elbow (Lefevre, 1984, 93-99). Conversation could then be viewed as a way of expanding and refining of repertoire of "internalized others" and so improving the individual's ability to invent.

However, Lefevre argues that if we expand our representation of invention to include social as well as individual activities, conversation can have benefits well beyond its role in

developing "inner communities." The ENFI projects, with their emphasis on online conversations as the medium of classroom exchange, illustrate some of the potential benefits for invention pedagogy of a more social, conversation-based approach:

1. Online conversation provides a naturalistic setting for introducing formalized heuristics. Some heuristics that we teach in the classroom, such as brainstorming and associational techniques like "cubing" (Cowan and Cowan, 1980, 21-22) often appear spontaneously in spoken or online conversation. The notion of formalized techniques for inventing may make more sense when they are presented as a more systematic way of doing activities which students have already experienced as natural and productive in a social context. The presence of the written transcript means that the teacher can take specific examples from previous discussions as illustrations when introducing the technique.
2. With the teacher online, the use of more advanced techniques can be demonstrated in context. One would not necessarily expect the questions from the tagmemic matrix, for example, to appear spontaneously in online conversation. However, Sandra Katz' (1984) dissertation research on the tagmemic matrix suggests that in-class demonstrations can have a significant impact on students' understanding and use of the matrix, making it more approachable and easier to internalize. The teacher using ENFI could provide an even more detailed demonstration than Katz was able to give in her study, including both an episode showing how a problem or topic can be explored using the matrix and an accompanying step-by-step verbal explanation of why he or she is proceeding in a particular way.
3. We could imagine new heuristics growing out of online conversation. For example, one of the principle problems that collaborators face is establishing a shared representation of the task they are trying to accomplish. Often

collaborators assume that such an understanding exists, when in reality each is proceeding with a radically different understanding of the primary goals and methods for their project. Mismatches in the task representation often do not reveal themselves until well into the project, costing extra time and effort. Using online conversation, we might develop an invention aid which encourages collaborators to make their task representations explicit from the beginning and gives them a notation (for example, a graphical scheme based on flowcharts or other similar notations) in which establish a shared understanding of the task.

Hence, although ENFI may not seem like an inventional tool at first, it may eventually have many implications for computer-based invention.

Implications for research

A more collaborative approach to invention aids promises both new benefits and new problems. Trent has discussed some of the potential benefits and problems of collaborative tools for writing pedagogy in a forthcoming book chapter (Batson, forthcoming). In addition to the pedagogical considerations, collaborative tools such as Cognoter and CB have implications for research as well.

First, such tools may make inventional activities more explicit. In the case of CB, for example, there are written transcripts of the discussions and even drafts that preceded any complete text, so influences of various kinds (personal, social, classroom) can be traced for their impact on invention. Perhaps by watching users of these tools carefully, we can see more of what they do and therefore fill in some of the missing pieces in our understanding of invention.

Second, we may find from our observations that the inventional behavior of groups is different from the inventional behavior of an individual. Stefik and his colleagues note, for example, that the groups who used Cognoter did not behave as the designers, working from a traditional model of the writing process, had expected. In least two situations, groups

using Cognoter imposed structure on the ideas being generated very early in the process (Stefik, et al, 1987, 44). They may have done so because working collaboratively gives rise to many more ideas than working alone, thus creating a need to group and manage ideas sooner.

However, such behavior does not fit well with research on solo invention such as that by Getzels and Csikszentmihalyi (1976). Their studies of painters suggest that in general those who delay longest before imposing structure on the first sketches toward a new painting produce works that are rated higher than those who impose structure early in the process (1976, 129-130).[1] In other words, we have evidence to indicate that for solo invention, delaying structure may be optimal while for collaborative invention, imposing structure early may be more appropriate. As we observe people using online collaborative tools for invention, we may be better able to characterize the unique features of individual and group invention as well as the features they share.

On the negative side, one potential danger that collaborative inventional tools pose for research is a kind of "forest and trees" phenomenon. Certainly such tools provide massive amounts of data, but a large body of data can be a mixed blessing if one is endeavoring to develop theory on the basis of that data. In the case of invention, for example, we already see that collaborative tools may be giving us insight into feaures of either two separate inventional processes (one for groups, one for individuals) or single shared process or most likely, a combination of both. Having data available will not automatically lead to

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[1]Getzels and Csikszentmihalyi found a correlation between what they call "concern for problem finding at the problem formulation stage" and quality of final painting as rated by expert judges. They assessed a subject's concern with "problem finding" in the early stage of work on a specific still-life painting with a number of converging measures: 1) the subject's explanation of why he did certain activities given in a followup interview, along with observational measures of 2) how long it took before the painting on which he was working contained all the essential elements of its final structure, 3) how often the subject interrupted his activities by switching medium or rearranging the still-life objects, and 4) how much the subject altered the still-life in his rendering of it. The last three of these measures concern the degree to which the subject settled on a final structure for the painting early, 2 and 3 explicitly and 4 by implication, since the fastest way of choosing a final form would be to copy the objects exactly rather than to reshape or regroup them imaginatively as the painting progressed. Among the subjects studied, those who delayed the choice of a structure longest produced the most highly-rated paintings.

appropriate conclusions about the relationship among the various inventional processes. We are likely to make a substantial number of data-based mistakes as we attempt to fit the potentially voluminous data of collaborative invention into an appropriate theoretical framework. We must be prepared to keep a view of the forest (that is, theory) rather than basing our conclusions solely on an examination of specific trees (that is, subparts of the data).

Conclusion

Focusing on collaborative invention is only one way of expanding the horizons for computer aids to invention. Some others include changing our assumptions about the end users of our aids (suppose the people using them were professionals instead of students...); linking our aids to invention aids from other disciplines, such as CAD/CAM and engineering workshop programs; and undertaking research on the role that prior experiences play in invention, which may lead to new kinds of tools. Certainly one need not believe that our often disappointing experiences with today's invention aids reflect an inherent flaw in computer-based invention. Instead, by shifting our assumptions about the contexts in which people invent, we may open new and more productive vistas for tomorrow's computer aids to invention.

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