

IdeaKeeper Notepads: Scaffolding Digital Library Information Analysis in Online Inquiry

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ABSTRACT

Online inquiry activities are important for K-12 learners to explore substantive driving questions in different areas, especially science. However, the inquiry process is complex for learners who need extensive support to mindfully engage in these activities. We are addressing this with the Digital IdeaKeeper, a scaffolded work environment for online inquiry. While online inquiry includes many different activities (e.g., planning, information seeking, synthesis), this paper focuses on supporting learners with information analysis so they can effectively read and make sense of articles they find in digital libraries. Here we spotlight scaffolded notepads, which connect to articles learners are reading in a browser. Notepads support learners by connecting their goals to their reading, guiding reflection and articulation, and implementing a framework by which learners' notes and articles are linked, saved and viewed together to aid with more seamless information management.

Author Keywords

Scaffolding, online inquiry, digital libraries, education

ACM Classification Keywords

H.5.2. [Information Interfaces and Presentation]: User Interfaces—graphical user interfaces; K.3.1. [Computers and Education]: Computer Uses in Education—computer-aided instruction

INTRODUCTION

Major science education standards (e.g., [8]) call for K-12 students to engage in online inquiry activities where they can investigate personally meaningful scientific driving questions. While there are several similar descriptions of online inquiry (e.g., [5, 6]), we can generalize it as being composed of the following activities:

- *Planning*: Articulating a driving question along with a description of what information might be needed to address the question (e.g., setting up information goals).
- *Information Seeking*: Gathering information related to the information goals, either by using some search engine or by utilizing information gathered elsewhere (e.g., data gathered from a probe).
- *Information Analysis*: Analyzing, reading, commenting on, and making sense of the information gathered.
- *Information Synthesis*: Comparing and putting together different pieces of information taken from different sources to write a scientific argument.

As information repositories, digital libraries can be especially useful for information seeking. Thus, there is an increased focus on information seeking support for K-12 learners, such as new collections in larger projects like the National Science Digital Library (NSDL) [14], and new search interfaces for children (e.g., [4]). But despite these efforts, current digital libraries focus primarily on information seeking and do not necessarily support other aspects of online inquiry. Thus digital library services need to be extended and augmented to fully support the range of activities and learner needs in substantive inquiry-based activities [7].

Our previous work has explored and articulated a learner-centered design approach to design *scaffolding* for software that helps novice learners engage in complex, intellectual activities in a manner conducive to learning [11]. Continuing in this vein, we are currently exploring scaffolded tools to support online inquiry. Our HCI contribution in this paper is an example of an approach to connect information resources (e.g., articles returned by a digital library) with a scaffolded construct—a *scaffolded notepad*—to support learners as they analyze and make sense of information they find in digital libraries during inquiry.

CONTEXT: THE DIGITAL IDEAKEEPER PROJECT

This paper describes an approach that addresses one particular inquiry activity—information analysis. However, this work is situated within a larger project addressing the overall online inquiry process. Specifically, we are developing the Digital IdeaKeeper, a scaffolded work environment for middle school students engaging in online inquiry. The IdeaKeeper integrates different tools and workspaces to provide functionality and scaffolding for online inquiry activities within a single, overarching environment.

IdeaKeeper provides different workspaces corresponding to each inquiry activity (i.e., workspaces for planning, searching, analysis, and synthesis). Each workspace integrates the tools and support needed to engage in the given activity. For example, in the information seeking workspace, IdeaKeeper integrates different digital libraries, such as the NSDL-affiliated Digital Library for Earth System Education [3].

One key inquiry activity where learners particularly need support is information analysis. While digital libraries are large storehouses of information, simply finding information like web-based articles or data sets is not enough for learners. In order to fully investigate their driving questions, learners need to put the information they find to use by judging the quality and understanding the content of different information resources. Therefore, learners need support, not just to find information, but also to purposefully read, annotate, and make sense of the information they find in digital libraries.

SCAFFOLDING INFORMATION ANALYSIS WITH THE IDEAKEEPER NOTEPAD

If we consider information analysis, we see there are three general areas that we want to support for learners:

- Learners need support to connect the information they find in digital libraries to the rest of their inquiry so they can tie the content they are reading to their information goals.
- Learners need support to help them productively reflect on the content they are reading and to articulate different notes and other information about that content.
- Learners need support to help manage both the information resources they find and their notes so as not be distracted during their inquiry.

These general learners needs have been gathered from the literature and from our observations of learners in different projects and contexts.

One approach we are taking with IdeaKeeper involves the development of scaffolded notepads to guide learners when they read an article returned by a digital library. (Traditionally, digital libraries return links to websites containing content. In this paper, we will refer to the content of these websites as *articles*.) When learners open

an article from the list of articles returned by a digital library, IdeaKeeper not only displays the article in a browser, it also connects a scaffolded notepad to the article in the browser to address some of the obstacles learners face with information analysis. Figure 1 shows an overview of the notepad/article combination in a web browser window, while Figure 2 shows a more detailed overview of the notepad. We will now consider each learner need in more detail and discuss how notepads can support learners with their information analysis.

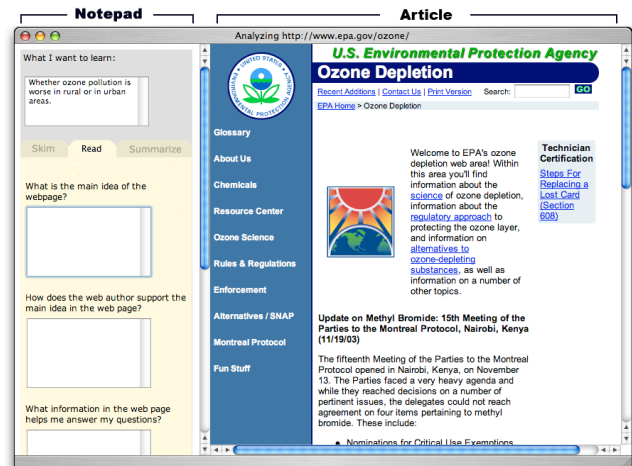


Figure 1: IdeaKeeper notepad with linked article

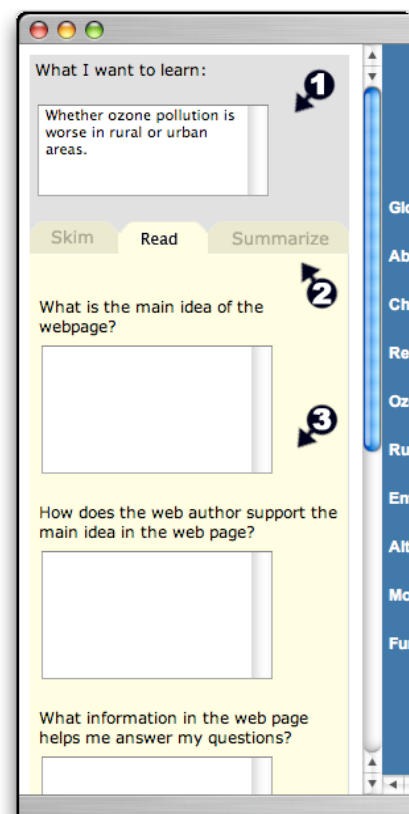


Figure 2: IdeaKeeper notepad in the “Read” activity

Connecting Article Content to Information Goals

One problem that learners face when presented with new material to read is that they may be overwhelmed enough to read without any overriding purpose. Learners may scan an article somewhat aimlessly, looking at the text without any clear inquiry goals in mind. [1]. Furthermore, learners may not know what important cues or specific content to look for in the document structure [12]. In terms of what we would like learners to do in an inquiry context, this can be problematic. If learners cannot effectively read the articles they find, they will have difficulty articulating a rich, informed argument to answer the question they are investigating.

IdeaKeeper notepads address this by linking to the information that learners wrote and thought about during their inquiry planning. For example, during planning, learners use another IdeaKeeper workspace to not only express their driving question, but also their information goals. These information goals are displayed again in every notepad (Item 1 in Figure 2). Thus notepads provide learners a simple reminder about their goals so they can read a given website in a more purposeful, goal-oriented manner. The notepad essentially links the important aspects of the planning and analysis contexts, so relevant planning information can guide the analysis activity.

Supporting Reflection and Articulation

Reading and making sense of a text involves more than just scanning the article's contents. Learners should also engage in reflection and articulation, which are important for learning [10]. Learners need to reflect on both the material they are reading and the connections between that material and the rest of the inquiry. Learners should also articulate information about the material they are reading to maintain notes about the text and express their current understanding so that further reflection on their notes (along with teacher guidance) can help them gauge and continue to build that understanding.

However, learners may lack knowledge about productively reflecting or articulating information, important tasks for developing understanding during inquiry [2, 10]. Learners need specific guidance on what to reflect on and structured opportunities for articulation. IdeaKeeper addresses this with the "Skim-Read-Summarize" area of the notepad (Item 2 in Figure 2). This area guides learners with their information analysis activities so they can:

- *Skim* the article to quickly assess it and its utility by considering different criteria about the article (e.g., the credibility of the author) and whether the main ideas of the article seem to be useful for the overall inquiry.
- *Read* the article in more detail, focusing on the main ideas in the article, the ways that the author supports the assertions being made, etc. Where the "Skim" section focuses on a general view of the article, the "Read" section focuses on a more in-depth view, where learners identify

ideas, evidence, and specific content that can shed light on the question they are investigating.

- *Summarize* the article, where learners can note in their own words what they learned from reading the article and what specific pieces of information may be useful for their pending argument.

The notepad primarily incorporates text prompts and text boxes, a common approach for supporting reflection and articulation (examples can be found in [10]). For example, the "Read" section of the notepad (Item 3 in Figure 2) has text boxes for learners to articulate the main idea of the article, how the main idea is supported, whether the article has information related to the information goals, etc. While a seemingly simple approach for learner support, there are different ways that prompts and text areas can be set up to support learners with their reflection and articulation (e.g., [2]). The key is that the notepad structure these activities so that learners can see what they should reflect on and look for as they read the text. A structured notepad can also provide areas to record useful information and summaries, allowing learners to articulate, reinforce, and identify gaps in their understanding.

Managing and Maintaining the Information Context

Often as learners are engaging in complex inquiry, management tasks can interfere with learners' cognitive focus, especially in computer-supported work that results in a large number of files [9, 10]. Learners who are trying to simply gain a foothold on new activities and complex content can easily be distracted by having to save or find significant artifacts or piece of information.

For example, in online inquiry, not only do learners have to organize and bookmark relevant articles from the master list returned by a digital library, but they also need to manage the different notes that they have written. Furthermore, as they review their notes, learners may need a straightforward way of recalling the original article to see the context in which they wrote those notes. While such management tasks can be merely annoying to experts, the resulting shift of cognitive focus can be detrimental to learners.

IdeaKeeper addresses this by making each notepad/article combination a single unit to facilitate saving and reviewing notepads and articles. For example, rather than simply bookmarking an article, learners can save both the article and the contents of the associated notepad—the two are viewed and saved as one conceptual unit, so the learners need only perform one save operation. When learners reopen an article, their notes for that article reappear in the connected notepad. This way, learners maintain the information context, seeing both the original article along with their notes. Because IdeaKeeper ties notes and articles together, learners do not have to worry about managing both their articles and their notes, which allows them to engage in their inquiry with reduced interruption.

FUTURE WORK AND CONCLUDING REMARKS

In some respects the inspiration for the notepad portion of the IdeaKeeper stems from the traditional paper-based “notecard” research approach that students are taught in school. What we are attempting to do with the IdeaKeeper notepads is to take this general idea, but improve on it with a computer-based implementation that scaffolds learners with information analysis. The “value added” of the IdeaKeeper notepads is to go beyond just giving learners a place to take notes and instead support them by linking other important inquiry information to their information analysis, structuring their reflection, giving them an opportunity to articulate information about their understanding, and facilitating management.

After gathering teacher feedback and design suggestions for IdeaKeeper, we are currently pilot testing it with small groups of 7th grade students to look at usability issues, see how students use the scaffolding for their inquiry, and gather their opinions of the software. In terms of the notepads, we are specifically interested in seeing whether learners use them to effectively read articles with more purpose and direction. Also, we want to see if learners write more (and better) notes about the articles they are reading and whether they incorporate their notes and other information in the arguments they write later. Following the pilot testing, we will revise the software for larger-scale tests in middle-school science classrooms, where students will use IdeaKeeper for longer inquiry projects.

In the end, we hope that different aspects of IdeaKeeper, such as the notepad approach, can serve as an example of how we can help people put information to use. Traditionally, information sources like digital libraries or the web have supported information viewing. But as others have noted we should explore ways to move towards “information literacy” where inquiry can serve as a means for people to put information to use by being able to effectively find, make sense of, and integrate information to address some decision or issue that they are interested in [13]. This is a goal of the IdeaKeeper project and we hope to illustrate ways of supporting learners in this endeavor.

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