
Aligning Web-based Tools to the Research Process Cycle: A Resource for Collaborative Research Projects

**Geoffrey P. Price
Vivian H. Wright**
The University of Alabama

Abstract

Using John Creswell's Research Process Cycle as a framework, this article describes various web-based collaborative technologies useful for enhancing the organization and efficiency of educational research. Visualization tools (Cacoo) assist researchers in identifying a research problem. Resource storage tools (Delicious, Mendeley, EasyBib) improve the collection and organization of resources for a literature review. Content development and management (PBWorks) as well as productivity (GoogleDocs) tools organize materials for researchers to write, view, edit, and analyze. Finally, various communication tools (Blogger, Twitter, Skype) improve the process of evaluating and reporting research.

Introduction

The ubiquitous presence of technology in society signifies that people willingly and eagerly adopt innovative techniques and tools for use in daily activities. Since farmers began harvesting crops, techniques such as crop rotation and tools such as the steam engine have improved the efficiency and effectiveness of agrarian work. The telegraph and telephone revolutionized communication. Digital technologies, such as the computer, altered how information is organized and accessed. Likewise, the proliferation of technology in education has enhanced teaching and learning activities in classrooms. The emergence of the World Wide Web in the early 1990s enhanced a valuable learning strategy: collaboration. Web tools provide a virtual medium for people to collectively meet and work without being in the same location. The emergence of web-based collaborative technologies not only revolutionized work in society, but also provided new techniques and tools for improving the effectiveness, efficiency, communication, organization, and collaboration of teaching and learning. Similarly, educational researchers can use web-based collaborative technologies to more efficiently organize, create, and share research with a variety of audiences.

Web 2.0

When Tim Berners-Lee unveiled the first web browser in 1991, this software application organized and presented information to users in a read-only format (Moschovitis, Poole, Schuyler, & Senft, 1999). The rise and fall of dot-com companies in the early 2000s showcased the creative and collaborative potential of web-based applications (O'Reilly, 2005). The participatory capabilities of an interactive Web 2.0 surpassed the once passive and unidirectional computing of Web 1.0 (Thompson, 2007). Whether an individual publishes a website using a wiki, stores photos and other

digital files in a virtual drop box, or shares a calendar, Web 2.0 tools necessitate an active experience between users and the Internet. Web 2.0 tools provide a user-friendly and interactive interface, facilitate content creation, establish social networking, and support collaboration among multiple users (Murugesan, 2007). Therefore, in addition to interaction of users with content and features of the web, Web 2.0 tools are identified by their collaborative nature. Users can interact with one another while utilizing the features of a certain tool. Therefore, Web 2.0 tools provide a place for multiple users to collectively complete a task on the web.

Research Framework

Creswell (2005) outlined six steps for conducting educational research in his Research Process Cycle. First, researchers *identify a research problem* to establish a focus for the study. Examining current issues in education, researchers identify a problem, justify why the problem warrants investigation, and explain the importance of potential results (Creswell, 2005). Next, researchers examine and *review the literature* to insure that the proposed study extends rather than duplicates existing knowledge on the selected topic. Researchers search a variety of mediums, organize resources, and summarize previous findings. After reviewing what other studies discovered, researchers *specify a purpose for research* to narrow the scope of a study. Researchers write a purpose statement, construct research questions, and develop hypotheses to guide research efforts. In order to answer the research questions and test the hypotheses, researchers must *collect data* from individuals using quantitative and/or qualitative methods. However, the raw data received from data is insufficient for answering research questions. Researchers *analyze and interpret data* to identify the meaning and examine the significance of the collected information. Finally, researchers *report research* to relevant audiences and *evaluate* the quality of a completed study. Web-based collaborative technologies can allow researchers to collectively participate in the research process through the use of visualization, resource storage, content development and management, productivity, and communication tools. The following sections describe tools applicable for each step of Creswell's Research Process Cycle, with the exception of *Data Collection* because of the sensitivity of data with third party web tools.

Identifying a Research Problem

During this first stage of the research process, researchers identify an educational problem, justify why an investigation of the problem is needed, and select audiences for whom the research study is intended (Creswell, 2012). According to Creswell (2005), researchers write a *statement of the problem* section specifying the topic, research problem, justification for the problem, gaps in existing knowledge, and potential benefits to reading audiences. Creswell recommends several strategies for writing these five elements of the *statement of the problem*. First, he urges researchers to "visualize this section as five paragraphs, with each paragraph addressing one of the five aspects of the section" (Creswell, 2005, p.71). The visualization of these sections helps researchers understand the flow needed to accurately depict the problem. Once visualized, researchers should write each section separately adding references from literature that provide evidence rather than opinions for statements put forth in each of the five sections. Therefore, researchers visually organize both their ideas and citations from literature before writing each section of the *statement of the problem*.

Web-based visualization tools allow users to digitally organize ideas using a combination of text, shapes, and/or images. Users strategically place objects on a blank "canvas" to portray their thinking. In addition, visualization tools offer formatting and styling capabilities, as found in most productivity tools, for differentiating both text and shapes. Cacao (www.cacao.com) is one such

visualization tool. Users import graphics, insert editable shapes, and manipulate a variety of stencils to create original drawings. Cacoo saves and stores diagrams on the web, automatically providing each user with the most updated version once an edit is made. A built-in chat room also provides the opportunity for synchronous collaboration while users are simultaneously working on a graphic. An editing history displays who edited diagrams and lists when recent changes occurred. Using visualization tools such as Cacoo, researchers can build a diagram of the five major sections related to writing a problem statement. Editors can insert arrows to indicate the sequence of thinking. Collaborators can add notes as text in boxes corresponding to each section. Formatting and styling can be applied different sections and highlight important points stated through text. The chat room feature and sharing capabilities allow collaborators to synchronously brainstorm each section.

Other widely used visualization tools include Gliffy and Webspiration, the web-based version of the popular concept mapping software, Inspiration. However, Webspiration is free for a 30 day trial period. Similarly, Gliffy requires a paid subscription to collaborate with other users on a diagram. We recommend Cacoo as its work environment most closely resembles the popular Inspiration, most of Cacoo's capabilities are free with a basic account, and we have utilized Cacoo to create and share concept maps.

Reviewing Literature

Researchers review existing literature to identify how others investigated similar problems. When completed, researchers write a summary of literature related to the topic identified in the *statement of the problem*. Creswell (2012) states that researchers should identify key terms or words to organize and focus the research. Next, researchers use a variety of mediums to search for literature based on the identified terms or topics and to select relevant literature for inclusion in the review. Creswell (2012) also recommends that researchers abstract or write annotations for selected literature prior to writing a review. Searching for resources, organizing by topic, and abstracting literature require a significant investment of time. Additionally, researchers often conduct research in various locations on multiple digital devices. Web-based resource storage tools help researchers more efficiently and conveniently organize and share resources in one accessible location.

Social bookmarking tools provide a "space" for users to digitally store resources collected during a web search. Additionally, users utilize the "tagging" capability of social bookmarking to organize resources using keywords or tags. After storing and tagging resources using a social bookmarking tool, researchers can view a "tag cloud" to identify themes or relationships among the literature. Additionally, researchers collaborating during this phase might utilize common tags to organize literature. Finally, social bookmarking tools provide the option of sharing access to the resources with other users.

Delicious (www.delicious.com) is a social bookmarking tool designed to save and categorize web resources. Users store web links in their Delicious account, accessible on any computer with an Internet connection. Users can share links with other Delicious users or follow the feed of another user to see what links they saving and tagging. Using Delicious, researchers can bookmark relevant websites discovered while searching for literature. Using the tagging feature, researchers can categorize links accordingly (i.e., methodology, conceptual, qualitative, and quantitative). Similar resource storage tools include Diigo and Pinterest, but we chose to highlight Delicious because it is an original social bookmarking tool and one that we and our colleagues have been using to share resources with one another.

EasyBib (www.easybib.com) is a citation tool that searches for and stores resources. Users can create a citation, categorize the resource with a tag, add an annotation, and share the resource with others. Similarly, researchers can search for literature within EasyBib and add annotations or record initial thoughts about the resource. The citation feature allows researchers to efficiently

construct a reference list while completing the literature review. Mendeley (www.mendeley.com) is a similar tool that serves as both a reference manager and academic social network for researchers. Users can search for articles, add external documents such as PDFs, and tag resources once saved in the account. However, Mendeley requires users to download a desktop application on their computer to view the documents. We chose to emphasize EasyBib because its web-only access permits researchers to collect, organize, and view resources from any computer with an Internet connection.

Specifying a Purpose for Research

Researchers narrow the scope of the study by specifying a purpose. Specifically, researchers write a purpose statement, research questions, hypotheses, and research objectives (Creswell, 2005). Since these sections guide what the research study will attempt to answer through data collection, Creswell (2012) asserts that each section “deserves special attention” (p. 109). Researchers write multiple drafts of these sections and ask for input from co-authors prior to finalizing the purpose statement and transitioning into data collection. Much of the narrative developed in this section is supported by literature collected in the previous stage of the Research Process Cycle. The development of these sections by multiple authors requires organization and collaboration among researchers that might not live or work within a close proximity.

Content development and management tools allow users to write on individual pages that are privately or publicly posted on the web. These tools allow researchers to access and update the content from any computer with an Internet access, regardless of a writer’s location. Furthermore, content management and development tools permit users to store digital files such as pictures, PDFs, and documents in the same location in which text is composed. Finally, administrators of the sites can grant varying permissions for individual files or pages based on a researcher’s role in the study. For this stage of the Research Process Cycle, researchers could organize each of the four sections on separate pages and assign permissions based on tasks assigned to each researcher. For example, the Purpose Statement page can be assigned to only those researchers responsible for developing the purpose statement. Some content development and management tools are web-based, acting like web pages in which multiple users can add and edit content.

PBWorks (www.pbworks.com) is a wiki tool where editors can write text, insert pictures, build tables, create hyperlinks, and store many types of documents. A wiki organizer can assign levels of involvement ranging from reader to editor. PBWorks tracks when changes to the site occur and who makes the edits. When developing a purpose statement, research questions, hypotheses, and objectives, researchers can collaboratively brainstorm and compose this information using PBWorks. Wiki organizers may construct a separate page for each of the sections mentioned above. Depending on designated roles, permissions in PBWorks specify which researchers can edit the content. Other content development and management tools include wikis such as Wikispaces and Google Sites and web-development tools such as Weebly and Wix. We chose to emphasize PBWorks over similar tools because of its versioning and file storage capabilities. PBWorks displays a “timeline” pane that indicates when the last edit or file upload occurred and identifies who completed the edit. Furthermore, PBWorks’ storage of external files is a bit more intuitive than similar content development and management tools we had used.

Analyzing and Interpreting Data

Once data are collected, organized, and stored, researchers must identify the meaning and significance of the information. Creswell (2012) identifies four essential steps for this phase: prepare data, analyze data, report results, and interpret the results. During the preparation of data, researchers transfer quantitative and qualitative data into a form conducive for analysis (Creswell, 2005). In other

words, researchers need to organize the data depending on the type of quantitative or qualitative analysis that is to occur. Productivity tools allow researchers to collaboratively combine data into one location and then utilize the various functions of productivity tools for analysis. This section highlights web-based productivity tools and describes their usefulness for preparing data for analysis as well as their usefulness for analysis.

The spreadsheet feature within GoogleDocs (www.docs.google.com) imports and displays data from similar spreadsheet programs such as Microsoft Excel. The share function permits multiple users to access the data simultaneously to edit and save the document. The share feature also restricts access of the document to invited users to insure the privacy of data and participants. Researchers can transfer data from the statistical program to a GoogleDoc and collaboratively discuss the data through a built-in chat room in the tool. The synchronous chat room enables users to communicate while each collaborator simultaneously edits the shared document. For example, when looking at the raw scores of a survey, researchers can use the chat room to collaboratively decide whether or not to discard a certain participant's responses. When the decision is made, all researchers can instantly view the revised data. As a result, researchers engage in a text-based dialogue about decisions regarding the data.

GoogleDocs also contains a word processing tool that functions similarly to Microsoft Word. Users can import text, alter the color and font, highlight text, and insert comments. When coding a transcript from an interview or discussion group, researchers often write notes in margins, underline significant phrases, and bracket important words (Creswell, 2005). Similarly, researchers can highlight certain text and insert a comment containing a thematic code for the text. Inserted comments in GoogleDocs specify both who made the comment and when it was added to the document. Furthermore, the share feature and the chat room foster a collaborative coding process. OfficeLive is a similar web-based productivity tool, but we chose to highlight the two types of GoogleDocs because we have both used GoogleDocs extensively in our teaching and research activities.

Reporting and Evaluating Research

Before finalizing conclusions and formatting a manuscript for publication, researchers identify an appropriate format for publication and evaluate the value of the research (Creswell, 2005). Researchers select a type of report (dissertation, journal article, conference paper) and develop an accurate understanding of the intended reading audience (Creswell, 2005; Creswell 2012). Once identified, researchers write a report targeted toward the identified audience. Once completed, researchers use criteria to evaluate the quality of their report (Creswell, 2012). For example, a researcher might assess whether their publication meets standards for publication in a certain journal or whether their publication extends the scholarly knowledge on a specific topic (Creswell, 2012). The information gathering about intended audiences, retrieval of example reports, and evaluation of completed reports is aided by input from others.

Communication tools allow users to correspond from a distance with external experts or colleagues. The tools are conducive for sharing files as well as bringing multiple users into a single synchronous or asynchronous discussion. Communicating with professional colleagues yields advice about the type of publication to create and suitable journals for publication. Conducted individually, such correspondence might delay progress. Twitter (www.twitter.com) is a micro-blogging tool where users can post up to 140 character messages to followers of the messenger. Therefore, instead of individual correspondence, a researcher might tweet a request for publication advice to a large audience eager to provide feedback.

Creswell (2005) states that researchers must constantly assess the quality of a study using appropriate evaluation standards. Skype (www.skype.com) is a video, audio, and text-based

communication tool where multiple users engage in synchronous dialogue. When connected in a call, researchers can discuss evaluation criteria without physically meeting in person. Additionally, when researchers desire feedback from a more diverse and expansive audience than the co-researchers, they can post excerpts from a study on a blog. Evaluators read the post and offer feedback through the comments feature. Blogger (www.blogger.com) is a blogging tool that allows users to post text, hyperlinks, and images directly to web. Blog organizers and writers can restrict access to the site to designated individuals. Therefore, researchers can limit the evaluation audience to protect the intellectual property. Additionally, researchers can moderate comments so that contributors are not influenced by previous reviews of a blog post.

Table 1
Research Process Cycle Steps aligned with technology tools

Research Process Cycle Steps	Technology Category	Examples
Identify a Research Problem	Visualization	Cacoo, Webspiration, Lucidchart, Gliffy
Review the Literature	Resource Storage	EasyBib, Mendely, Delicious
Specify a Purpose for Research	Content Development and Management	PBWorks, Wikispaces, Weebly, Wix
Analyze and Interpret Data	Productivity	GoogleDocs, OfficeLive
Report and Evaluate Research	Communication	Twitter, Blogger, WordPress, Skype

Concluding Remarks

Web-based collaborative technologies can enhance specific tasks when conducting educational research. From the initial steps of stating the problem through the reporting of findings, the capabilities of visualization, resource storage, content development and management, productivity, and communication tools can improve efficiency and organization. As with any form of technology, researchers must be aware of the limitations and challenges of utilizing web-based collaborative technologies.

Innovative research methodologies using web-based collaborative technologies might undergo scrutiny from institutional review boards. For example, when collecting data through online surveys or web-based audio recording tools, the privacy and the protection of participant responses can raise concerns. The online retrieval and storage of data makes it susceptible to online vandalism and copyright infringement (Luo, 2009). Because of the sensitivity of data and anonymity of participants in this stage of the research process, we chose not to describe web-based collaborative technologies useful in the *Data Collecting* phase.

Collaborative research brings together individuals from varying demographics and disciplines with a philosophy and bias towards how research is best conducted. Researchers attempting to incorporate web-based collaborative technologies into their research studies might encounter resistance from collaborators. Some will deny the value of technology's usefulness for enhancing existing practices or methods. Others might see the value, but don't believe they have the

knowledge, skill, or time to overcome the learning curve required to use some tools (Boulos, Maramba, & Wheeler, 2006).

The proliferation of web tools has created a plethora of options for conducting collaborative educational research. As the capabilities of web-based technologies evolve, educational researchers must continually evaluate how the capabilities of certain tools can improve the efficiency, organization, and collaboration of their studies. While this article described tools useful for each stage of the research process, we recommend that researchers choose one tool and focus on its effective application for a specific research task. Once researchers master the tool for the desired purpose, researchers might expand their repertoire of tools for other research tasks.

References

- Boulos, M., Maramba, I., & Wheeler, S. (2006). Wikis, blogs and podcasts: a new generation of web-based tools for virtual collaborative clinical practice and education. *BMC Medical Education* 6 (41). doi: 10.1186/1472-6920-6-41
- Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Upper Saddle River, NJ: Pearson Publishing, Inc.
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Boston, MA: Pearson Education.
- Davies, J. & Merchant, G. (2009). *Web 2.0 for schools: Learning and social participation*. New York: Peter Lang Publishing, Inc.
- Luo, L. (2010). Web 2.0 integration in information literacy instruction: An overview. *The Journal of Academic Librarianship* 36(1), 32-40. doi: 10.1016/j.acalib.2009.11.004
- Murugesan, S. (2007). Understanding web 2.0. *IT Professional* 9(4), 34-41.
- Moschovitis, C. J. P., Poole, H., Schuyler, T., & Senft, T.M. (1999). *History of the Internet: A chronology, 1843 to Present*. Santa Barbara, CA: ABC-CLIO.
- O'Reilly, T. (2005). What is web 2.0: Design patterns and business models for the next generation of software. Retrieved from: <http://oreilly.com/pub/a/web2/archive/what-is-web-20.html?page=1>
- Reiser, R. (2001). A history of instructional design and technology: Part I: A history of instructional media. *Educational Technology Research and Development* 49(1), 23-64.
- Thompson, J. (2007). Is education 1.0 ready for Web 2.0 students? *Innovate: Journal of Online Education*, 3(4).