AC 2008-1334: USING VIRTUAL TEAMS TO IMPROVE INFORMATION LITERACY AND DISTRIBUTED COGNITION IN A COLLABORATIVE WRITING AND GENERAL CHEMISTRY ASSIGNMENT

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Using virtual teams to improve information literacy and distributed cognition in a collaborative writing and general chemistry assignment

How might individual information literacy skills contribute to the work of the group? Would a cross-curricular assignment generate observable communication related to distributed cognition during virtual team activities?

Introduction

Two collaborating faculty developed a linked assignment in a general education chemistry course and an upper-level technical writing course. The goals of our collaboration were to foster students' control, awareness and demonstration of learning, improve student information literacy, and cultivate students' negotiations with team members. We use the term "distributed cognition" to describe virtual interactions among students that led to fulfilling the goals of the linked assignment. Students' information literacy skills "funded" the pool of knowledge for student teams to access as they address the problems posed by their assignment to build a presentation.

Definitions

Information literacy (also known as information fluency) is an umbrella concept encompassing library instruction, computer literacy, critical thinking, communication, ethics, and lifelong learning. The Association of College and Research Libraries (ACRL) defines information literacy as "the set of skills needed to find, retrieve, analyze, and use information"[1] and presents information literacy standards for science, engineering and technology.[2] Information literacy enables learners to "master content and extent their investigations and become more self-directed, and assume greater control over their own learning".[3]

Lave and Wegner proposed that "situated learning" occurs within the context of a "community of practice", a "set of relations among persons, activities, and world, over time and in relation with other overlapping communities".[4] They claimed that in the community of practice, learning results from the structure of practice, rather than exclusively from the structure of pedagogy; a novice progresses through various stages of participation, including learning the specialized tools and discourse of the community. Ben-Ari, speaking as one engaged in science education, emphasizes the role of curricular content as well as the learning activities in the communities of practice.[5] Robey, Khoo, et.al, extend community of practice to "virtual" communities in their study.[6]

Donath, Spray, Alford, et. al. used the term, "distributed cognition" to explain the integrated contributions of team members,[7] where every person contributes to the learning of every other person. Cognition, rather than an individual function, is an activity distributed among persons and their environment. Donath and partners identified seven speech events associated with active learning: critique, elicitation of critique, internalization and awareness of knowledge gained, contextualization and explanation of research or related ideas, negotiations and consensus-building. These speech events signal an emerging community of practice. They concluded that awareness of knowledge-making speech events can help educators facilitate active group learning.

The assignment and activity

Collaborators in this paper had shared their teaching philosophies emphasizing the importance of active learning, teamwork, and information literacy(fluency), and were motivated by recent work in distributed cognition to develop a linked cross-curricular virtual team assignment in their chemistry and writing courses over several years. The assignment was a pre-lab activity to general education chemistry course students and a secondary research activity to upper division technical writing course students. Students were to search for information about how chromatography techniques/tools are used in their major fields (e.g. aviation, engineering technology), write a summary of searched information, and build a presentation as a team of four to five students. Faculty guided students toward effective project-management skills focusing on information and time management. In the chemistry course, information fluency instruction was also provided with partnering college librarians. Students were to write a summary reflecting the subject (chromatography), the discipline (chemistry), time management, and the learning process, and articulating connections among them. Technical writing students were to conduct research, write summaries, share files, manage the virtual meeting space, and participate as team members.

Virtual team activities provided collaborative learning environments. Each student interacted with asynchronous virtual communications and utilized file-sharing features to contribute/retrieve individual/team work using "group files" to build a team presentation. Teams were to work on a common goal to solve a problem, contribute information, and share tools. Students were asked to take the initiative of assigning roles within a team (e.g. a file manager, a communicator, an editor). The chemistry faculty identified the students from the technical writing course who had previously taken the chemistry course and encouraged their contributions as "knowledgeable peer"/"experienced peer" with their chromatography lab experiences.

Technical writing course students wrote summaries of relevant information based on retrieved articles, and posted the original and the summary to "group files". Students were to read each others work in preparation for planning and building a PowerPoint presentation. The software automatically labeled each uploaded version of the PowerPoint chronologically, allowing individual students to create a section of slides and upload them to the group, so that a student editor could compile a final version. Files were tagged with the author's name and date-stamped, and served as the project progress log. The software met best practices for collaborative learning environments, such as support for shared construction of knowledge, shared objects, tools for negotiation, public and private feedback features, division of tasks, and joint online commentary.[9]

Faculty monitored group progress such as communication content and path, frequency of file upload, download, and frequency of viewing by each student, as well as the development of presentations in a timely manner. Faculty intervened to point out lack of progress in a team, or provided instructional guidance on content that might enhance student team work. Individual student and/or team's information literacy competency was observed during project process and final presentation evaluation.

Collaborators keyed their objectives to University student learning outcomes, information literacy standards of the Association of College and Research Libraries, and TAC of ABET criteria (Appendix A).

Our students were to demonstrate information literacy competency skills by

- Providing an example of the application of chromatography in their community of practice
- Composing a team PowerPoint presentation conveying researched information to peer
- Documenting the group process of creating the PowerPoint using virtual team software
- Performing the presentation

During information literacy instruction, the chemistry instructor initiated basic information literacy tools such as the logic of Boolean operators, the Advanced Google utility to limit domains returned, and the process of manipulating results through keyword phrases. Students also benefitted from the library's portal tailored for the general education chemistry course, "Chemistry Section" web site, constructed to ensure that students' initial navigation resulted in reliable resources.

Chemistry students started with a pre-writing invention worksheet, which served as a brainstorming tool in pre-search activities, a recording journal of search processes, a guiding tool to understand the architecture of the information gateway (See Appendix B). In an individual conference with a librarian, students received feedback on their overall search process. This process and its merits were presented in details previously.[8]

TAC of ABET Criteria 2e requires that graduates should demonstrate an ability to function effectively on teams. Students are asked to elect roles based on their strengths:

- A file manager to organize the virtual files (e.g. minutes, notes, articles, summaries), including the evolving PowerPoint;
- A communicator/task manager to contact faculty with issues and problems and to keep the group coordinated and on task;
- An editor to focus on producing the final version of the organizing the work of team contributors. (A useful guide for helping teams self-evaluate their group performance can be found in Appendix C).

<u>Goals, Outcomes, and Assessment</u>

Faculty goals for the linked assignment were accomplished as indicated below:
(a) Foster students' control, awareness and demonstration of learning:
Students controlled their searches, revealed their awareness of learning, and demonstrated the content of their new knowledge in their written summaries, Power Point presentations and post-presentation evaluations. They also displayed competent information management (or lack thereof) in their team presentations. Typically, a group would describe what they learned about a

routine aspect of their program through the inquiry process. (For example, the role of chromatography in grading fuel quality, for aviation maintenance students).

(b) Improve students' information literacy skills:
Students learned to search effectively for information in science databases, and to glean relevant information to the purpose at hand. Chemistry faculty found students more effectively utilized their time throughout the research process, because their search strategy became more deliberate and less random with their careful annotation of the process. The pre-writing worksheet provided sequential support to students while highlighting the meta-cognitive heuristics so essential to strategic searching. The often-documented tendency for students to short-cut the information search process was circumvented by teacher expectation for strong documentation and communication, and teacher oversight of the group files.

The chemistry instructor has surveyed students' perceptions of information literacy over a period (2004-2007) and has reported findings in detail previously.[8] Students' overall perception of library instruction, computer literacy, critical thinking, communication, ethics, and lifelong learning as information literacy components has steadily increased. Students spend more time on research and writing, according to their self-statements, (on average from 2.9 hours in 2004 to 8.7 hours in 2006).[8] Most importantly, the instructor has observed a distinct improvement in the quality of cited references, as well as the quality of the search process and path.

(c) Foster students' negotiation with team members:
Students negotiated and built consensus, one of Donath's active learning speech events,[7] in message board/e-mail communications, and in some years, face to face meetings. Our students demonstrated the concept of distributed cognition[7] in the relationships among files, emails, face-to-face interactions, PowerPoint graphics, sequentially archived PowerPoint versions, the final oral presentation, and learning. Virtual teaming enhanced distributed cognition, because group files were accessed by individuals at their convenience. The communication demands of distributed cognition were met competently.

Conclusion

The collaborative initiative led to refinements of learning objectives and the pedagogical activities to achieve them. Cross-curricular endeavors amplified teaching effectiveness of each teacher and strengthened their collegial communication to make the assignment meaningful for themselves and their students. Individually and collectively, beneficial learning was observed while important objectives were attained in student communication of learning (e.g. information literacy, science literacy, teamwork skills and virtual communication skills) supporting lifelong learning, TAC of ABET criteria 2h. Ancillary objectives such as computer literacy and leadership were informally observed. Collaborators observed various forms of student's leadership, which was fluid within groups and usually functional, meaning individuals served as leaders when situations arose, and the contribution was appropriate.

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[7] Donath, L., Spray, R., Thompson, N., Alford, E., Craig, N., Matthews, M. (2005) Characterizing Discourse Among Undergraduate Researchers in an Inquiry-Based Community of Practice. Journal of Engineering Education. Vol. 94, no 4 pp 403-417

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Appendix A: Keying Faculty/Librarian objectives to university learning outcomes
Chemistry assignment: Chromatography

English Faculty Objectives and student activities	Chemistry faculty objectives and student activities	K-State University student learning outcomes supported	TAC of ABET criterion 2	Association of College and Research libraries standards and outcomes for higher education
(b) Contribute relevant, high-quality researched information to virtual teams; (c) plan, meet, communicate, design and (a) deliver team presentations using effective technical communication techniques	Integrate discipline specific pre-lab with science literacy, information literacy, and communication skills, to foster life-long learning.	Knowledge (content area chromatography) Critical Thinking (information retrieval synthesis, summary, writing, planning) Communication (during small group meetings, written summaries, group oral presentation).	a. mastery of knowledge, techniques, skills, modern tools g. effective communication h. a recognition of the need for, and an ability to engage in lifelong learning	2.2 d Construct a search strategy using appropriate commands 3.1 a-c Read text, restate concepts in own words, quote appropriately
Students meet face-to-face and virtually with chemistry students. Integrate Information literacy and graphic skills; function as effective team members, perform presentation.	Students search for information about how a particular technique/tool is used in their major fields. Write a report on their learning process reflecting the subject (chromatography), the discipline (chemistry), information management, time management, and connection of what was learned with an application in their everyday life	Diversity (working effectively in teams) Academic and professional integrity (Using high-quality, professional-standard information without plagiarism)		

(a) = control, demonstration, awareness of learning
(b) = Information literacy: effective contribution of high-quality, relevant information
(c) = Negotiation and consensus building
italics = knowledge-related objective or learning outcome
underline = communication-related objective or learning outcome

Appendix B: Prewriting/Invention Worksheet for “Chromatography” report in the Chemistry course

Plan: (before starting a search)

My field of study/major is:
Keywords to consider using are:
Search engines or databases that I usually use are: because:
I plan to use this database first, because:

Action/Process to find and evaluate information. (While performing a search)

First set of search tools used:
First set of keywords used:
Initial search outcomes are or not matching my expectation because:
I need to narrow or expand my search option, areas, etc. because:
Changes that I am making (keywords or databases):
I need to work more on: because:
Initial evaluation search sources and outcomes are reasonable because:

Additional Notes:

questions and ideas
lessons learned
suggestions to myself, peers, teacher and librarians

Summary:

Source
Talks about:
Follow-up additional work after reading this article
Initial session ending time with faculty/writing staff signature
Follow-up session starting date/time and ending time with faculty/writing staff signature
Work done at home: make note of staring and end time
Appointment with librarian: (date, time)
Appointment with Writing Center (date, time)