2005-2007 LITRE Grant Proposal

1. Project Title:

Collaborative Online Concept Mapping

2. Project Coordinator:

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4. College or Unit:

Education

5. Department:

Curriculum and Instruction

6. Project Description:

The investigators propose to establish a networked implementation of cMap server software, which will allow university students to work in teams and collaboratively construct online concept maps to illustrate their understanding. Students will individually download the free cMap desktop application to their own personal computers, and through the grant, will be able to access the new cMap server. The server will provide a virtual location for students to collaboratively build maps as part of class assignments and to store media artifacts and resources attached to their maps. Both cMap server and cMap desktop software are provided free of charge through the Institute for Human and Machine Cognition (IHMC, 2005) at the University of West Florida. cMap is one of the more powerful concept mapping applications available, because it allows students to develop either individual or collaborative maps, and it allows students to attach a multitude of resources to developed concepts (e.g., Web links, image files, word processed files, video clips, etc.). cMaps are comprised not only of traditional links and nodes, but also of rich resources that further help students explain their understanding in a system reminiscent of electronic

portfolios.

Concept mapping applications serve dual purposes in providing students with an active learning tool to build and revise a model of understanding, and in providing instructors with a dynamic assessment tool to accurately determine what students know about a subject and how that knowledge is structured. Concept maps are a truly "authentic" assessment measure, because they clearly depict what students know about a topic and how they inter-relate the course information. Misconceptions can be readily identified.

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7. Project Objectives:

The project investigators are currently conducting a pilot study to investigate differential applications of the cMap tool, with students downloading cMap software to their personal desktop computers and developing individual maps of important course concepts. In ECI 511, students are developing individual concept maps based on their own analysis of course readings and discussions (a wholly independent activity). In EAC 595a, students are working collaboratively to identify weekly course concepts on a discussion board and wiki, followed by individual student mapping of these important, group-identified terms (a collaborative-independent activity). In the pilot, students are only able to generate concept maps independently because the technology, in the form of a server, is not currently available at NC State.

The proposed project takes the pilot study a step further, in allowing the investigators to establish a server-based implementation of cMap and investigate activities whereby small teams of 2-3 students collaboratively identify important course concepts using a WebCT Vista group space AND collaboratively build a group cMap together (a wholly collaborative activity). The proposed project would allow the investigators to study the quality of concept maps developed by small groups of 2-3 students, and whether group maps depict better understanding than individual maps.

Objective 1: Implement cMap server software on a new Web server, establishing a virtual network space that allows students to build collaborative concept maps and store attached resource files.

Objective 2: Create an expert map for each course, and then compare student maps to expert maps in terms of correctly identified propositions, eliciting a numeric map score (see assessment plan).

Objective 3: Use cross-case analysis to identify differences across student maps in terms of organizational structure and level of detail (see assessment plan).

Objective 4: Investigate different strategies for concept mapping in classrooms (e.g., individual mapping vs. collaborative mapping, differences in approach between instructor use); determine which strategies yield better relational measures; determine differences in the organizational structure and level of detail in maps across these different strategy applications (see assessment plan).

Objective 5: Determine how many students prefer concept mapping and authentic assessment to traditional assessment, and whether certain learning styles might be used to predict this preference. Categorize student difficulties and questions to describe the processes students go through as they develop maps individually and in small groups (see assessment plan).

Objective 6: Determine interest in collaborative concept mapping from different audiences: other university classes in the College of Education, Centennial Middle School classes, and faculty committees and project teams with the need for a virtual space to structure information around a topic or research issue.

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8. Estimated number of students affected:

The proposed project involves two different graduate classes in the College of Education during Fall 2006: ECI 511 (Computer Applications and Curriculum Integration), and EAC 595a, Special Topics, Classroom Assessment and Evaluation. Enrollment in these two classes is approximately 15 students each and both are currently taught online, although ECI 511 will be taught face-to-face during Fall 2006. Project investigators Oliver and Raubenheimer are pilot testing cMap with these same classes this semester (Fall 2005). They are using concept maps differently in their two courses, with Oliver using them on an ongoing basis, and Raubenheimer having students create them half way through the course and again at the end. Raubenheimer identifies student preconceptions through a written assignment at the beginning of the semester, while Oliver identifies these through a preliminary mapping assignment during the first week of classes. The primary difference between the pilot and experimental studies is how students develop maps--as individuals Fall 2005, and in small groups of 2-3 students Fall 2006.

The cMap server will be reserved for the experimental classes Fall 2006, but will be open to other classes in the College of Education in the Spring of 2007. Since it is common practice to use concept mapping applications like Inspiration and Kidspiration with students in K-12 schools, long-term interest in the college is likely for providing pre-service teachers with exposure to concept mapping applications like cMap. Through our repeated concept map workshop with DELTA's LTS, we will determine interest in the cMap server from other colleges on campus, and provide access to others as requested and as space on the server allows.

After the proposed project, the cMap server will also be open to instructors at the Centennial Middle School for concept mapping activities, and to Education research teams who might employ the cMap virtual space as a planning tool for developing frameworks with links to associated documents.

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9. Outcomes of the Project:

1. Students will work in small groups of 2-3 students to discuss and synthesize weekly course readings and assignments, toward the goal of identifying the most important course concepts during a given week.

[Supports LITRE dimensions a) problem solving and b) empirical inquiry, by helping students learn to extract the most important elements from a body of literature--a skill needed for effective problem solving and inquiry; and d) performance in the discipline by identifying key concepts from weekly coursework.]

2. Students will work in small groups of 2-3 students to visually map the concepts they've chosen to represent the major course ideas, including lines and propositional statements that describe the nature of the relationship between concepts (e.g., "concept x is an example of concept y," or "concept x refutes the theory of concept y," or "concept x provides supporting evidence for concept y," etc.).
[Supports LITRE dimensions a) problem solving, and b) empirical inquiry, by helping students learn to relate different sources of information and generate propositions about that data--skills needed for problem solving and inquiry tasks as students map out what is known about a field of study before generating a hypothesis for further study; and d) performance in the discipline by identifying the relationships among key concepts from weekly coursework.]

3. Students will work in small groups of 2-3 students to attach to their maps, the most appropriate resources that help to elaborate or provide examples of the concepts in their maps (e.g., Web links, articles, excerpts cut from a class discussion board, etc.).
[Supports LITRE dimension c) research from sources, by helping students learn to select the most important evidence that best supports an argument they wish to make; and d) performance in the discipline by identifying the most appropriate resources for the particular discipline.]

4. Students will work in small groups of 2-3 students to critique the maps of other groups, noting major differences between their conceptualizations and those of other teams.
[Supports LITRE dimensions a) problem solving as students critically analyze the maps of others and identify ways to improve them; and d) performance in the discipline, by identifying missing/incorrect information or connections in the maps of others and by preparing current and future educators to professionally evaluate one another's work--a skill used frequently in the teaching profession through peer classroom observation and mentoring.]

5. The investigators will evaluate different applications of electronic concept mapping (individual and collaborative) and how these different strategies impact conceptual development in terms of correct propositions, organizational structure, and level of detail (i.e., Do group mapping tasks lead to better conceptual development than individual mapping tasks?) (see assessment plan).

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10. Project impact on NCSU:

Concept mapping has attracted recent attention at NC State, with the library and DELTA's Learning Technology Service (LTS) purchasing a license for the Open Mind concept map tool, and installing the tool in the main library's ITTC labs. The project investigators are teaching a new workshop through LTS this

fall, discussing the concept map as an assessment technique, and providing hands-on practice with two tools (Open Mind and cMap). Despite a renewed interest in mapping, supported course tools at NC State (WebCT Vista and Wolfware) do not include mapping capabilities. It is important to study mapping through this LITRE grant, as a strategy for supporting student synthesis of information and conceptual understanding. The results can be used to help the university make decisions regarding a future site license or infrastructure for mapping. Leaders with DELTA may be interested in results, as they decide on PowerLinks or plug-in applications that can provide increased functionality for WebCT Vista.

As more distance education programs are created on campus, faculty and administrators may be interested in concept mapping as an authentic assessment technique. The difficulty in delivering and securing traditional tests at a distance without the need for expensive proctors is well known. Mapping projects may provide educators with an alternative option to gauge the understanding of distance students.

The cMap tool not only provides students with mapping features, but also with virtual space to attach assignments, articles, notes, images, and various media. In many ways, cMap mimics the capabilities of more expensive portfolio programs, but extends these capabilities by requiring students to structure included resources in a visual, conceptual framework. Depending on how instructors structure cMap assignments, students can leave a course with a well-developed map or portfolio that showcases everything they have learned. Subsequently, students can reflect back on this artifact as a point of reference for future courses.

Finally, this project provides NC State faculty with information on the concept mapping technique, low-cost and easy-to-use tools for carrying out mapping projects, data on the most appropriate applications of mapping (e.g., individual versus collaborative), and examples of what students can produce and come to understand when tasked with mapping.

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11. Project Assessment Plan:

The project assessment plan consists of the following major data sources: student maps with expert map, student survey, index of learning styles questionnaire, and student question log. Student maps are the primary data source.

1. Assessment of Student Concept Development

All student assignments that relate to developing core concepts will be graded and responded to by the instructor each week. Grades between sections will be compared. Also, discussion postings will be analyzed qualitatively between class sections (instructor vs instructor; individual vs collaborative) to identify strategies students use to identify core concepts, including through the use of concept maps.

Outcome 1 is addressed by this part of the assessment plan.

2. Assessment of Student Concept Maps

A concept map may be assessed on the basis of:
--concepts or nodes usually depicted by a square or circle on the map;
--lines and arrows that link concepts together into clusters or hierarchies;
--propositions or statements on the lines between concepts that describe how two concepts are related (e.g., x "is an example of" y); and
--resources or elaborative examples attached to the concepts themselves (e.g., Web links, articles, annotations, notes, excerpts cut and pasted from a class discussion board, etc.).

As reported by McClure, Sonak, and Suen (1999), several techniques are available to assess concept maps: holistic, or scoring a map for the overall understanding represented; structural, or scoring a map on the basis of higher-level structures, crosslinks between clusters, and propositions; and finally relational, or scoring a map on the basis of propositions only. In a study of the three techniques with different pairs of raters, the relational method was found to be most reliable. The cognitive load on raters was reduced, allowing them to focus on comparisons between an expert map and student maps. Further, scores obtained from the correctness of propositions are more likely to correlate with state and national standardized tests (Rye & Rubba, 2002). In contrast, scores obtained from a set of diverse measures (the structural method), lack a correlation with conventional assessment scores. Overall, the relational approach is recommended for its ease of use and mechanical simplicity, allowing scores to be easily defended (McClure et al, 1999).

For the proposed study, both investigators will develop an expert map which identifies primary course concepts and propositions. Using the expert map as the basis, both investigators will analyze student maps from each other's courses on the presence of correct propositions (the relational method), providing two raters for each map submitted. Map scores from the pilot study will be compared to map scores from the experimental study, to help answer the question, do different applications of concept mapping (i.e., wholly individual, collaborative-individual, or wholly collaborative; and different instructor uses) yield different relational scores?

Student maps in each section will also undergo a qualitative cross-case analysis, to determine differences in how students chose to organize concepts (e.g., hierarchies, clusters), and in how students chose to break down course concepts (e.g., micro-level, holistic). The cross-case comparison will include an examination of the two different courses and the way students developed concept maps, to identify differences that result due to the way instructors required students to use the cMap software in the course. This analysis will help answer the question, do different applications of concept mapping yield different map structures?

As students work in groups to critique the concept maps of others, the instructors will keep a record of the discussion postings and comments. These comments will be analyzed qualitatively to identify what improvements students suggest to the maps of their peers.

Objectives 2, 3 and 4, and outcomes 1, 2, 3, and 4, are addressed in this part of the assessment plan. This part relates specifically to WHAT and HOW students learn using concept maps with cMap software.

3. Student Survey

A student post-survey will be developed to determine what value students attributed to the concept mapping process (e.g., do students plan to use maps for reference after the course, do students plan to save their map with resources as a type of portfolio, do students find their maps to be a good indicator of what they have learned, would students use maps in their own teaching, would students prefer traditional assessments or concept mapping tasks, etc.). The survey will also determine what prior experiences students had with concept mapping before the courses, since these experiences might effect how well students were able to adapt to the mapping tasks.

The survey will contain Likert scale type items that will be analyzed quantitatively, as well as open-ended responses that will be analyzed qualitatively for emerging themes and trends relating to factors that impacted student learning.

Objective 5 is addressed in this part of the assessment plan.

4. Index of Learning Styles Questionnaire

Students in the pilot and experimental classes will be asked to complete the Index of Learning Styles Questionnaire available online (Solomon & Felder, 2005). Results from the learning styles questionnaire will be compared to specific questions on the student survey to determine if students with certain learning styles have a stronger preference for the visual-oriented concept mapping task, in lieu of traditional assessments.

Objective 5 is addressed in this part of the assessment plan.

5. Question Log

Both investigators will log student questions during Fall 2005 and Fall 2006, to determine technical, procedural, conceptual, or collaborative difficulties students face when implementing concept mapping. The logs will be analyzed qualitatively for emerging themes and trends, relating specifically to what helped or hindered students' learning.

Objective 5 is addressed in this part of the assessment plan.

6. Interest from other audiences.

The two investigators will keep a record of all interactions with others who are interested in using concept maps in their classes. This will include a record of people who attend the workshop they run on concept mapping through Learning Technology Services.

This assessment item addresses objective 6.

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12. Staffing and Support:

Kevin Oliver, Investigator, will receive funds to purchase a quality Web server, which will be put to use as a dedicated concept map server running cMap server software. The purchase will include a backup device. Kevin will teach ECI 511, Fall semester 2006, and carry out the assessment plan as described. Summer salary for preparation and analysis work requested.

Dianne Raubenheimer, Investigator, will teach EAC 595a, Fall semester 2006, and carry out the assessment plan as described. Stipend for summer preparation and analysis work requested.

Phil Emer, Director of Technology and Operations at the Friday Institute for Educational Innovation, will provide guidance in selecting an appropriate server, assist with installing the necessary applications, and support the ongoing cMap server project with frequent backups. The server will be physically housed at the new Friday Institute for Educational Innovation.

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13. Financial Support Requested:

EPA salary total: 2500
SPA salary total:
Other salary:
Equipment: 4500
Cost associated with assessment: EPA salary above
Other financial support requested:
Total Funds requested: 7000
Additional Explanation of how funds will be used:

Equipment funds will be used to purchase a high-end server with monitor, such as a rack-mountable Apple Xserve G5, dual 2.3 Ghz, with a pair of 80 GB hard drives and 2 GB of RAM. The actual purchased server may change to a similar unit reflecting more current technology in 2006. The Friday Institute will house and backup the server.

EPA salary costs associated with the assessment plan include $2500 for: spring 2006 salary/stipend for the two investigators to analyze pilot study maps, and to prepare student assignments, assessment instruments, and procedural handouts for fall 2006 ($750 each); and, spring 2007 salary/stipend for final map analyses and reporting ($500 each).

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14. Funding Breakdown:

Total funding requested for fiscal year 2005-2006: 6000
Total funding requested for fiscal year 2006-2007: 1000

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15. Staff Support and/or Technical Support Requested:

References

IHMC. (2005). Cmap tools: Knowledge modeling kit. Retrieved August 31, 2005, from http://cmap.ihmc.us/

McClure, J. R., Sonak, B., & Suen, H. K. (1999). Concept map assessment of classroom learning: Reliability, validity, and logistical practicality. Journal of Research in Science Teaching, 36(4), 475-492.

Rye, J. A., & Rubba, P. A. (2002). Scoring concept maps: An expert-based scheme weighted for relationship. School Science and Mathematics, 102(1), 33-44.

Solomon, B. A., & Felder, R. M. (2005). Index of Learning Styles Questionnaire. Retrieved August 30, 2005, from http://www.engr.ncsu.edu/learningstyles/ilsweb.html

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16. Timetable for Implementation:

Spring 2006, analysis of pilot study data, preparation of new expert maps and assignment sheets for fall classes

Spring 2006, acquire server and test collaborative mapping applications, prepare student tutorial/instructional forms on how to access and use the online collaborative mapping application

Fall Semester 2006, conduct study in two classes, collect data according to assessment plan, market cMap tool to other interested parties in the College of Education and Centennial Middle, repeat concept mapping workshop through DELTA's LTS and share preliminary findings from pilot and experimental studies

Spring Semester 2007, analyze data according to assessment plan, prepare final report to LITRE, repeat concept mapping workshop through DELTA's LTS and share findings from pilot and experimental studies

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17. Human Subjects Protection:

If your proposal project involves research using human subjects, you will need approval from the Institutional Review Board for the Protection of Human Subjects in Research (IRB) prior to final approval. IRB information is available at http://www.ncsu.edu/sparcs/irb

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18. Proposal Release:

By submitting this proposal the applicant grants the LITRE Advisory Board permission to make this proposal available as an example for future grant applicants. All personal information will be removed if this proposal is used as an example.