Development of Online ThinkSpace to Increase Students’ Problem-Solving Skills

Proposal Categories:
- Proposals that facilitate interdisciplinary, cross-College projects.
- Proposals for truly innovative projects that “push the envelope” and are not likely to be funded through other funding streams;

Proposers: Craig Ogilvie (Physics and Astronomy Department),
Holly Bender (Department of Veterinary Pathology)
Peter Boysen (IT Services Academic Technologies)
Cinzia Cervato (Department of Geological and Atmospheric Sciences)
Jared Danielson (Department of Veterinary Pathology)
Roberta Di-Terlizzi (Department of Veterinary Pathology)
William Gallus (Department of Geological and Atmospheric Sciences)
John Jackman (Department of Industrial Engineering),
Barbara Krumhardt (Department of Genetics, Development, and Cell Biology)
Dale S. Niederhauser (Department of Curriculum and Instruction)
David Russell (Department of English)
Sarah Ryan (Department of Industrial Engineering),
Allan Schmidt (Center for Excellence in Learning and Teaching)
Ann Marie VanDerZanden (Department of Horticulture)

Colleges: LAS, Engineering, Human Sciences, Agriculture, and Veterinary Colleges

Signatures:

Dean, College of Liberal Arts and Sciences  Dean, College of Engineering

Dean, College of Human Sciences  Dean, College of Agriculture

Dean, College of Veterinary Medicine  Associate CIO

Project Leader: Craig Ogilvie, 294-2219, cogilvie@iastate.edu
2. Project Overview and Expected Benefit

A. Description and Category Fit:
Progress in our technological society requires that people entering the workforce have strong quantitative, problem-solving and diagnostic skills. Yet most students struggle when faced with unfamiliar problems because the problem-solving tasks typically encountered in school require use of limited strategies like identifying and applying formulae or strategies found in textbooks. However, solving complex real-world problems requires in-depth conceptual understanding of content and metacognitive skills that allow one to formulate solution strategies, implement a course of action, and reflect on solution viability from different perspectives. Our approach is to have students engage in a challenging online problem-centered learning environment, and to scaffold support while they practice these higher-order skills. Iowa State University faculty teams have independently developed three higher-order learning tools: problem-solving learning portal (PSLP), Diagnostic Pathfinder (dP) and myCase. Our goal for this proposal is to complete the work to build a new tool, ThinkSpace, that incorporates the best features of these tools. Our long-term goal is to provide opportunities for all ISU students to develop essential problem-solving skills.

Course management systems like WebCT offer quizzes, essays or assignments, yet they do not allow scaffolding of complex, real-world problems. ThinkSpace provides an environment to author and deliver cases to a broad range of ISU students. The faculty on this proposal will be using ThinkSpace in their courses and plan to expand the use of this learning tool via workshops and faculty support, making ThinkSpace a truly interdisciplinary, cross-college project.

In 2008 we received a CAC grant to design ThinkSpace to include the best features of the existing case tools. The server-side software is almost complete. This software manages the content, as well as links to WebCT, authentication of users and case-authors, etc. The interfaces that the students and faculty will use have been designed and are currently being developed. Some screen shots of these are included in Appendix A. ThinkSpace now has two classes of complex problems

- Multi-stage problems have a specific goal, e.g. formulate a diagnosis in vet med, or make a recommendation on extending the capacity of a factory, or what is ailing some trees in landscape management. Rich, complex information is made available to students and they complete a series of tasks such as justifying their decisions, or forming a visual map of their hypotheses. These tasks provide a structure for students to develop their problem-solving skills.
- Situation problems where students have to first identify the main challenge, e.g. the students are asked to recommend how a company could grow. The possible directions are not constrained by the instructor. Often the resources are delivered over a period of time to simulate real-world conditions and instructors may take on roles to provide more authenticity.

The focus of this current proposal is to develop ThinkSpace so it can be used in ISU classes. The key milestones are to test ThinkSpace with a few small enrollment courses in Fall 2009, e.g. a graduate course in education and an upper-level class in veterinary medicine and to roll-out ThinkSpace for use in large enrollment ISU courses in Spring 2010.

B. General Student Benefit
PSLP is currently being used by 1400 students per year at ISU in courses ranging from horticulture, physiology, physics, teacher education, and industrial engineering. We anticipate faculty and students who use PSLP will begin using ThinkSpace in Spring 2010. Diagnostic Pathfinder (dP) has been in use in regular coursework since 2000, and in that period of time has been used by thousands of veterinary students at Veterinary Schools in the U.S. and Canada. Pathfinder was designed for teaching Clinical Pathology, but in the past two years its use has expanded to teaching Toxicology, Parasitology and Pharmacology as well. In 2008 we also ran workshops with CELT and worked one-on-one to introduce more faculty to the use of ill-structured problem-solving. Approximately eight to ten new faculty are now designing or using cases (via PSLP or dP) in their courses. When ThinkSpace is complete in Fall 2010 we will hold additional faculty development...
workshops on ThinkSpace and anticipate additional adoption by 6-10 new ISU courses. ThinkSpace could have an impact on over 3500 ISU students per year by the end of the project period.

The main benefit of ThinkSpace for students is to improve their problem-solving skills. ThinkSpace

- Provides more information than is necessary to solve a given problem, but still constrained to the resources provided within the portal. Students develop skills of first analyzing problems and from there selecting the needed information.
- Provides structure and scaffolding to students.
- Tracks student pathways: do students frame the problem, or first search through resources? We can analyze this info to give feedback to students so they can improve their approaches.

C. Innovation:
Development of ThinkSpace in the past year built a software framework using Web2.0 technologies. This proposal will extend the innovations from last year's grant by adding
- A user interface that allows drag-and-drop hypotheses and path-building
- Communication tools and conferencing software using Red5/OpenMeetings open source software
- Real-time information requests, e.g. diagnostic test data for vet med cases, real-time prices and information for business cases, and weather information. The first test application for real-time data will be Geology's Dynamic Weather Forecasting tool (DWF) in ThinkSpace.

D. Cost Efficiency:
Previously the PSLP, DP, myCase, DWF and eDoc projects were separate, each requiring hardware and support. Bringing these projects under one umbrella would result in considerable savings, providing a system that integrates with other campus systems, is supported by ITS, and could provide a future home for other educational projects supported by CAC.

E. Integration:
ThinkSpace can be added to any webCT course and grades from projects/cases will be included in webCT's gradebook. The login for thinkSpace will be via ISU's standard login.

F: Description and intended purposes of expenditures:
- Interface and server-side software development (Computer Science graduate student I)
  - Finalize server-side software
  - Code student and faculty interfaces for multi-phase problems
  - Add communication conferencing tools
  - Scripts to port content from PSLP, pathFinder, myCase to ThinkSpace
- Specialized user interfaces (Computer Science graduate student II)
  - Path-building drag-and-drop user interface for forming hypotheses, adapted from DP.
  - Integration of requests for real-time information, pioneered for DWF cases
  - Reporting tools that provide instructors with key info, e.g. the number of manipulations (moves) of items while constructing diagnostic paths; how similar a student's diagnosis is to the expert's; which resources students use in a case study, as well as the sequence students use to access the resources.
  - Evaluation of usability for students and faculty adopters (CIT graduate student)
    - Provide rapid information to the development team about users' experience with the first versions of ThinkSpace so that this feedback can be used to improve the tool.
    - Faculty and student usability information will come from interviews, surveys and focus groups.
- Technical assistance, undergraduate in meteorology for the global data needed for DWF
  - Sort through the data sources and test the DWF with data from outside the U.S.
- Wiki documentation for both students and new faculty.
  - One graduate student in technical communication to design and code the wiki.
- Porting/cleanup/testing of existing cases, including testing the cases, and fixing any problems.
- Pedagogical support from an education graduate student or senior vet med students for new instructors to ill-structured problem solving. Without this guidance, new faculty often design problems that are too limited in scope.
3. Support and Maintenance

The tool's sustainability at ISU requires that ThinkSpace be released as open-source software so that maintenance can be shared across multiple universities. At ISU, ThinkSpace will be maintained by Peter Boysen as part of the suite of tools sharing a common infrastructure, e.g. eDoc. CELT plans to continue to sponsor faculty development workshops.

4. Budget

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<th>Total Cost by Funding Source</th>
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Appendix A  Initial ThinkSpace interface

A) User is initially presented with their own space which they can customize with their own "apps" like a file library, eDoc or mashups of other web-based application

B) Multi-staged problem with gathering of information and specific tasks for students to complete, e.g. forming a hypothesis or diagnostic path. These tasks are specified by the instructor and act as a scaffold for the students.

C) We do not yet have a mockup of a "situation" course organization however it will provide communication and file management tools for open-ended group situations.