

## **“Studying Online Collaborative Learning at the Math Forum” Project Summary**

The **project goal** is to determine through quantitative and qualitative methods if a small group of online learners can build knowledge that exceeds the knowledge of its individual members, and to study how this happens when it does.

The **project motivation** is that contemporary frameworks of learning theory stress the social (inter-personal, intersubjective) nature of knowledge building and recommend the fostering of collaborative learning in small groups. However, it is hard for many people to comprehend the idea of collaborative group knowledge distinct from and potentially exceeding the knowledge of the individual group members. There is little clear and incontrovertible evidence that online groups can construct knowledge that exceeds what any of the group members knows. It is important to study precisely how this can take place in order to design effective collaborative curriculum, technology and assessment methods. The proposed research does this in a concrete educational context.

The **project approach** is to develop an evidentiary base for computer-supported collaborative learning (CSCL) as applied in the Math Forum, a popular digital library used from classroom and home settings. By rigorously studying the learning process of online small groups solving specially designed problems in school mathematics, the project provides a strong research foundation for expansion of Math Forum services from an audience of primarily individual students to a virtual community of systematically matched groups of learners. It studies core social aspects of human learning (ROLE quadrant 2) within a context of math learning in educational settings (quadrant 3).

The **project objectives** are to study favorable conditions for building collaborative knowledge, including constructive criteria for group formation, for curriculum design and for technology support. The project will study the interaction of group and individual knowledge, and develop rigorous, cumulative, reproducible and usable methods for analyzing and interpreting the relevant data. The central working hypothesis of this project is:

- H0 (collaborative learning hypothesis): A small online group of learners can (on occasion and under favorable conditions) build knowledge and understanding that exceeds that of its individual members.

Other project working hypotheses guide specific objectives:

- H1 (collaborative group hypothesis): Small groups are most effective at building knowledge if members share interests but bring to bear diverse backgrounds and perspectives.
- H2 (collaborative curriculum hypothesis): Educational activities can be designed to encourage and structure effective collaborative learning by presenting open-ended problems requiring shared deep understanding.
- H3 (collaborative technology hypothesis): Online computer support environments can be designed to facilitate effective collaborative learning that overcomes limitations of face-to-face communication.
- H4 (collaborative cognition hypothesis): Members of collaborative small groups can internalize group knowledge as their own individual knowledge and they can externalize it in persistent artifacts.
- H5 (collaborative methodology hypothesis): Quantitative and qualitative analysis and interpretation of interaction logs can make visible to researchers the online learning of small groups and individuals.

The **project team** of this multidisciplinary researcher/educator collaboration consists of: five co-PIs; curriculum teams consisting of student teachers, classroom teachers and Math Forum staff; technology teams including Math Forum technical staff and three graduate research assistants; and teams of national and international CSCL researchers assisting with methodology development and the study of group cognition. PI Stahl has developed numerous collaborative learning environments and has published on related issues in CSCW and CSCL theory and methodology. Co-PI Weimar has been Director of the Math Forum since its founding in 1994. Co-PI Bach is professor of educational technology. Co-PI Shumar is an educational ethnographer and long-time evaluator of the Math Forum. Co-PI Robertson is a cognitive scientist who teaches quantitative research methods and natural language processing. The Math Forum has a substantial, experienced staff. Some two dozen national and international researchers with relevant specialties are collaborating on this project.

**Intellectual merit.** This project addresses straight-on a central hypothesis of collaboration theory and CSCL that has never been adequately clarified and documented. It studies this issue in the context of extending the services of one of the most successful online educational institutions, simultaneously studying closely related issues of group composition, curriculum design, technology support and assessment methodology. The project brings together five co-PIs with the required mix of expertise, along with teams of engaged educators and researchers.

**Broader impact.** The project develops rigorous methods for studying a controversial issue in educational theory: the online construction of group knowledge that can exceed individual knowledge. It reconciles basic research and educational practice by providing a research base for CSCL and for virtual learning communities like the Math Forum. It develops public mechanisms to bring diverse individuals from around the Web together to learn.