

**Research Abstracts**  
**CLTW Research Forum**  
**April 26-27, 2007**

*Arranged in Alphabetical Order by First Author*

**AN EDUCATIONAL ETHNOGRAPHY OF TEACHER DEVELOPED SCIENCE CURRICULUM IMPLEMENTATION: ENACTING CONCEPTUAL CHANGE BASED SCIENCE INQUIRY WITH HISPANIC STUDENTS**

Eric Brunsell, Montana State University Doctoral Fellow

*Theme III Culture and Learning: Connection between culture & learning for students from diverse groups and Professional Development on culture and learning*

Abstract: An achievement gap exists between White and Hispanic students in the United States. Research has shown that improving the quality of instruction for minority students is an effective way to narrow this gap. Science education reform movements emphasize that science should be taught using a science inquiry approach. This study investigates two questions. First, what are teachers' perceptions of science inquiry and its implementation in the classroom? Second, how does the use of a specific science inquiry model affect the learning of students in a predominantly Hispanic, urban neighborhood?

Five teachers participated in a professional development project where they developed and implemented a science unit based on a model of science inquiry instruction. Three units were developed and implemented for this study. This is a qualitative study that included data from interviews, participant reflections and journals, student pre- and post- assessments, and researcher observations.

This study provides an in-depth description of the role of professional development in helping teachers understand how science inquiry can be used to improve instructional quality for students in a predominantly Hispanic, urban neighborhood. These teachers demonstrated that it is important for professional development to be collaborative and provide opportunities for teachers to enact and reflect on new teaching paradigms.

**LOST IN TRANSLATION? MULTICULTURALISM IN AMERICAN ENVIRONMENTAL EDUCATION PROGRAMS**

**Jennifer Cox, University of Montana Master's Fellow; Blake Ingram, University of Montana Master's Fellows**

*Theme III Culture and Learning: Connection between culture & learning for students from diverse groups and Theme V: Research on Connections between Program Evaluation, Public Policy and Achievement gaps*

Abstract: Are foreign exchange students able to translate and apply the knowledge and skills gained in American Environmental Education (EE) programs to their native culture? In other words, can a foreign exchange student translate the information gained in an EE class in American culture to another? The reason for this type of study is to hopefully increase the ability for EE programs to affect change in diverse populations. If a program is based on a culture the students find irrelevant to their lives, the program has potential to fail in its mission to affect change. It is for this reason that a correlation between culture and EE programs needs to be

addressed to maximize global understanding of environmental issues. In order to answer these questions two components must be addressed. First, a sampling of environmental education programs must be analyzed for methods of addressing multiculturalism. Second, current research on foreign exchange students taking EE programs must be examined for successes and failures. To find this out, a literature review will be performed to discover how environmental education, diversity, and cultural relevance are interconnected. A proposed method of sampling of EE programs could be through a survey that focuses on program type, student population, and the point of view of institutions.

### **A FOCUS OF THE PLACE NAMES PROJECT TO BUILD CROSS-CULTURAL RELATIONSHIPS: A VIEW OF ECOLOGY**

Jeff Crews, University of Montana Doctoral Fellow; Michael Munson-Lenz, University of Montana Masters Fellow

*Theme III Culture and Learning: Connection between culture & learning for students from diverse groups and Professional Development on culture and learning*

Abstract: The focus of the Place Names Project (PNP) is to build cross-cultural relationships between traditional Bitterroot Salish, and Pend d'Oreille world views and science using geospatial technologies; Remote Sensing, Geographic Information Systems (GIS), and Global Positioning Systems (GPS) and traditional cultures. This will be done by establishing relationships with Confederated Salish and Kootenai tribal entities and use their input to identify appropriate and accurate information necessary to develop a culturally responsive curriculum entitled The Place Names Project.

This curriculum, being developed with help from the Center for Learning and Teaching in the West, will serve to help engage middle school students in understanding how culture affects ones view of ecology through personal and familial connections with their surroundings and help to foster a better understanding of the relationships that exist between the Salish people and comparable lands. Each module will be designed using place-based and inquiry teaching strategies and will align with the Essential Understandings regarding Montana Indians and the Montana State Science Standards.

### **OPENING MATHEMATIC ACHIEVEMENT SYSTEMATIC REVIEW DATABASE TO OTHER CLT-WEST DOCTORAL FELLOWS FOR RESEARCH PURPOSES: A ROUNDTABLE PRESENTATION**

James J. Dugan, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps and Theme I Defining/Understanding Critical Dimensions of Achievement Gaps*

Abstract: Presentation will provide a short summary of the systematic review on interventions in secondary and post-secondary mathematics with at-risk students nearing completion. The objective is to explore the level of interest of other CLT-West campuses to gaining access to the research database of 3,800 citations published between 1990 and 2004.

Summary: The systematic review on interventions in secondary and post-secondary mathematics with at-risk students is being offered to other CLT-West campuses as a resource for doctoral fellows research. Study goal was to identify interventions most effective for improving mathematics achievement while reducing the achievement gap. Five potentially effective

interventions were identified: pedagogical/instructional interventions of cognitive/metacognitive strategies, cooperative learning, and peer tutoring; technology-based interventions; and school restructuring (block scheduling primarily) interventions. No curricular interventions could be identified as effective. Discussion Questions

1. What interest do other CLT-West campuses have in accessing the database?
1. What types of research projects could be support through the database?
1. What computerized and/or online tools are available to assist other doctoral fellows in accessing and using the database?

My objective would be to leave this session with adequate information to determine if providing access to the database would be of value to other the doctoral fellows. In addition, I hope to gain suggestions as to how access could be established and an idea of any cost or purchased resources that might be needed.

## **A SYSTEMATIC MAPPING REVIEW OF INTERVENTIONS IN SECONDARY MATHEMATICS WITH AT-RISK STUDENTS – OVERVIEW**

James J. Dugan, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps and Theme I Defining/Understanding Critical Dimensions of Achievement Gaps*

Abstract: Nations today require skilled, knowledgeable workforces and citizens with a sound understanding of mathematics and science (National Science Board, 2004). To compete in the international or “world” market, the U.S. economy is dependent on individuals with higher levels of mathematics, science, engineering, and technical skills. Recent data shows that only 23% of 12-grade students are ranked as proficient or above in mathematics problem-solving – 77% are not (Schneider, 2007). The intent of this study is to perform a systematic review of mathematics interventions with secondary and postsecondary at-risk students to determine “what works” in mathematics achievement. Research Questions:

1. What are the characteristics of curricular interventions that are most effective in reducing the math achievement gap for at-risk secondary students?
1. What are the characteristics of instructional interventions that are most effective in reducing the math achievement gap for at-risk secondary students?

Methodology: A multiphase coding of studies for inclusion was done. Results of this review include both descriptive and systematic mappings of the literature base. A meta-analysis of effect size estimates for main effect and for at-risk factors was conducted.

Results and Conclusions: No curricular interventions could be identified as effective. Five interventions were identified as potentially effective including three pedagogical/instructional interventions (peer tutoring, cooperative learning, and cognitive/metacognitive strategies), along with technology-based and school restructuring (block scheduling) interventions.

National Science Board. (2004). Science and engineering indicators 2004. Retrieved November 30, 2004, from <http://www.nsf.gov/sbe/ere/seind04/c1.htm>

Schneider, M. (2007). Performance of 12th-graders. Retrieved February 23, 2007, from [http://nces.ed.gov/whatsnew/commissioner/remarks2007/2\\_22\\_2007.asp](http://nces.ed.gov/whatsnew/commissioner/remarks2007/2_22_2007.asp)

## **ASSESSING THE IMPACT OF THE EXPEDITIONARY LEARNING MODEL ON A NEW SCIENCE-MATH OPTIONS SECONDARY SCHOOL FOR UNDERSERVED STUDENTS**

Mike Ellison, Portland State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Presenting science and math content in “real world” contexts; Theme IV Research on Connections between assessment strategies and achievement gaps*

Abstract: As a CLTW doctoral student at Portland State University in the Center for Science Education, I am beginning to develop my dissertation proposal. I plan to work with a 6-12 option school emphasizing science and math in the Beaverton School District in a Portland, Oregon-area suburb. The school, the Beaverton Science Academy, will open in fall 2007. It is designed to serve the district’s mostly Hispanic minority population. The school will open with only 9th grade. It has a grant from Expeditionary Learning Schools to implement their model. Currently, the planning team for the Science Academy is recruiting students and planning their curriculum and school structures. I have been meeting with the planning team this spring. The team is grappling with introducing the Expeditionary Learning model in the ninth grade biology course to be offered next year. The Expeditionary Learning model is based on the premise that an effective learning community is formed when students are challenged by a curriculum based on “learning expeditions” designed around critical content presented in a context compelling to students. Expeditions feature linked projects and service that require students to construct deep understandings and skills and to create products for real audiences. I am interested in researching the impact of the Expeditionary Learning model on the students in the Science Academy. That model will be presented, along with research plans for assessing the impact of the model. Design and validation of an assessment model is being considered.

## **COSMOS: A GROUP-MENTORED STRAND TO INTRODUCE MICROBIOLOGY TO HIGH SCHOOL SENIORS**

Josephine Ebomoyi, University of Northern Colorado Post Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Presenting science and math content in “real world” contexts*

Abstract: With the current emphasis on teaching of Science and Mathematics to improve scientific literacy, knowledge of the microbial world and its scientific applications is essential for young aspiring high school students. The goal of the Center for Learning and Teaching in the West (CLTW) is to improve learning and teaching through innovative ideas that could ultimately bridge achievement gaps. The students who participated in this learning experience were part of the COSMOS program. COSMOS traditionally has mentored rising seniors in the program with one-to-one research program. The 2005 summer term was the first time a group strand was added. Students chosen for this new strand (referred to as the group-mentored strand) were those less socially and cognitively mature from their cohorts. Using the part instructional model proposed by Bybee, 1993, it was hoped that students would be able to: perform general microbiological laboratory techniques in a cooperative learning situation and individually design their own research projects by cooperatively drawing on their collective ideas. Students filled out a Likert scale type survey concerning attitudes and perceived benefits of cooperative learning experience. Social benefits of cooperative learning were noted as indicated by most (67-86%) agreeing to relevant survey questions. Students’ performance on laboratory activities, quizzes

and essays were evaluated. Of the participants, 43% received a grade of A while 57% received a grade of B. These scores, along with formal oral presentations and posters compared favorably with the students in the one-to-one research program.

### **SCIENCE INQUIRY GROUP PROFESSIONAL DEVELOPMENT PROGRAM**

Irene Grimberg, Montana State University Research Faculty

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Professional Development strategies to reduce achievement gaps*

Abstract: This presentation focuses on the design and implementation of a professional development science program model -the Science Inquiry Group (SIG)- that addresses the characteristics and needs of teachers on and near Indian American reservations in Montana. Aligned with the goals of CLTW of promoting the teaching and learning of 3-12 science in order to reduce the achievement gap, the SIG model explores the tensions between standard-based science teaching and the cultural characteristics of Native American classrooms. The incorporation of both: Effective standards-based practices for Native American students (Apthorp et al., 2003) and the Montana Standards for Science (OPI, 2006) framed by a constructivist approach to learning resulted effective for enhancing teachers' professional background. A rich PD experience of two and half years is documented describing the program model, rationale, curriculum, and activities. A reflection on this experience and suggestions for future work are also discussed. References: OPI (2006). Draft version. Apthorp, H. S., DeBassige D'Amato, E., & Richardson, A. (2003). Effective standards-based practices for Native American students: A review of research literature. Aurora, CO: Mid-continent Research for Education and Learning.

### **TEACHERS' EXPECTATIONS OF STUDENT PERFORMANCE**

Ricarda Hanson, Montana State University Doctoral Fellow

*Theme III Culture and Learning: Connection between culture & learning for students from diverse groups and Theme I Defining/Understanding Critical Dimensions of Achievement Gaps*

Abstract: This presentation will present results from a teacher validation study that was conducted with the Iowa Tests of Basic Skills (ITBS) and the Iowa Tests of Educational Development. Classroom teachers were asked to indicate their perceptions of students' reading and math proficiency levels prior to reviewing tests. Results will be presented that compare teachers' predicted proficiency levels with the actual proficiency levels based on test results.

### **THE USE OF COMPUTER ALGEBRA SYSTEMS IN A PROCEDURAL ALGEBRA COURSE**

Jonathan Harper, Montana State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Use of technology to reduce achievement gaps; Discourse as a tool to reduce achievement gaps*

Abstract: An introductory, undergraduate algebra curriculum was redesigned using computer algebra systems (CAS). CAS was used as a tool to facilitate classroom discourse and promote deeper understanding of procedures according to a Framework for Procedural Understanding. The study of these strategies are contributing to efforts to improve the teaching

and learning of algebra, specifically for developmental math students at the undergraduate level. The first implementation of this curriculum is nearing completion. Data gathered through student and teacher interviews, observations, and written exams will be used to address three research questions. First, what issues arise for the teacher and the students when CAS is introduced in the classroom and discussion is organized around the Framework for Procedural Understanding? Second, how is the level of procedural skill affected by the introduction of CAS? Third, is there a difference in Framework-based procedural understanding between treatment and control students? Examples of classroom activities utilizing CAS and assessment items designed to measure Framework-based understanding will be presented. Preliminary findings will be shared based on available and upcoming classroom observations, Framework-based quiz results, and student interviews. Discussion will also focus on plans for final data collection and analysis.

### **A SYSTEMATIC MAPPING REVIEW OF INTERVENTIONS IN SECONDARY MATHEMATICS WITH AT-RISK STUDENTS: INSTRUCTIONAL INTERVENTIONS – TECHNOLOGY-BASED INTERVENTIONS**

Laurie Hillman, Colorado State University Doctoral Fellow; Dora Gonzales, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps and Theme I Defining/Understanding Critical Dimensions of Achievement Gaps*

**Abstract:** This presentation summarizes data on technology-based interventions. The overall study goal was to identify interventions most effective for improving mathematics achievement while reducing the achievement gap. This intervention was supported by twenty-one empirical studies with fourteen of the twenty-one yielding positive effect size estimates.

**Summary:** Following the information presented on the systematic review overview, this presentation focuses on the usage of technology-based interventions in mathematics with at-risk students. Three primary areas in technology-based interventions were identified: computer-aided instruction (CAI), integrated learning systems (ILS), and the usage of graphing calculators. Background information, including a summary of previously published systematic reviews on technology-based interventions, along with the preliminary results of this intervention summary, will be presented. Comparisons of effect size estimates of two disadvantaged at-risk factors (female gender and low-academic achievement) are made with the main effect size estimates. Results show that the usage of technology-based interventions favor females but yield mixed results for students of low-academic achievement.

### **OCKLEY GREEN MAGNET SCHOOL: IMPACTS THAT A CONTEXTUALIZED SCIENCE CURRICULUM HAS ON STUDENTS' LEARNING AND ENGAGEMENT**

Sybil Kelley, Portland State University Doctoral Fellow

*Theme III Culture & Learning: Connection between culture & learning for students from diverse groups; Theme II Teaching and Learning Approaches to Reduce Achievement Gaps and Theme I Defining/Understanding Critical Dimensions of Achievement Gaps*

**Abstract:** My research is part of an ongoing partnership between PSU's Center for Science Education and Ockley Green Magnet School in North Portland. Ockley Green is undergoing transformational change, becoming an integrated arts, science and technology

magnet school, as well as nearing the end of its first year of transition from a middle school to a K-8 model. This research is designed to document and disseminate the findings from the school's transformational change process in both the short and long term. Our research group has been involved in the school as co-teachers, co-researchers and participant observers.

Using a mixed-methods design, I want to explore the complex systems involved at the school – specifically the students, teachers and classroom environments. More specifically, this research will focus on science learning and teaching taking place at 6<sup>th</sup> grade. Through our partnership, I have had the opportunity to co-teach science with two other teachers. This has provided an opportunity to investigate the impacts that a science curriculum contextualized around local environmental issues has on students' learning and engagement. In the short-term, this will be done using a series of classroom work samples, interviews and focus groups. Longer-term, this cohort of students will be monitored through 7<sup>th</sup> and 8<sup>th</sup> grade, and ultimately a quantitative analysis of their state science test scores will be compared to past cohorts of students. Throughout these analyses, the culture of the school and the nature of relationships within it will be described and explored to provide context.

### **MASTERY WITH MEANING: ACCESS TO MATHEMATICS ONLINE**

Paul Kennedy, Colorado State University Co-PI and Research Faculty; Wade Ellis, Colorado State University Doctoral Fellow, Department of Mathematics, Westvalley College, California; Janet Oien, Colorado State University Masters Fellow; Jerry Overmyer, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Presenting science and math content in “real world” contexts; Use of Technology to reduce achievement gaps and Theme IV Research on Connections between Assessment Strategies and Achievement Gaps*

Abstract: The use of computer mediation along with online internet platforms as a means of delivering instruction is increasing as new technology is being developed to support online learning. Mastery approaches, in particular, have been proven to alleviate students' deficiencies and open the door to higher mathematics. This paper will detail some of the current existing programs using online learning for precalculus courses and review related research, including current literature about online mathematics learning and the effectiveness of online learning. It will then detail how the research informed the design, development, and implementation of a new online approach developed for the PACe precalculus mastery program at Colorado State University. (PACe is an acronym for “Paced Algebra to Calculus electronically.”) Finally, preliminary research results comparing student success rates and retention will be detailed along with next steps in the design of comprehensive research initiative dealing with student achievement and retention.

### **TEACHERS SELF-EFFICACY AND THEIR RELUCTANCE OR INCLINATION TO UNDERTAKE PROFESSIONAL DEVELOPMENT**

Karen Koski, University of Northern Colorado Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps; Professional Development strategies to reduce achievement gaps*

Abstract: Science is constantly changing and science teachers need to be constantly updating their scientific content knowledge as well as their pedagogical knowledge yet many

teachers do not know of new ideas in the field because they do not participate in professional development activities where they would learn the new information. Some middle and high school teachers look forward to participating in professional development activities while others avoid it as much as possible.

By looking at the possible barriers teachers face when trying to participate in professional development along with their self-efficacy and their need for cognition I hope to develop a list of characteristics of teachers who do and do not participate in professional development. The characteristics can be a first step for a school district to look at to try to change the inaction of some of their teachers.

My research questions are: 1) Do teachers with lower self-efficacy participate in professional development activities less often than teachers with higher self-efficacy?; 2) Do teachers with a higher need for cognition participate in professional development activities more often than teachers with a lower need for cognition?; 3) Do teachers who participate in less professional development create more barriers for themselves?

Using a quantitative survey with a qualitative follow-up of some participants Colorado middle and high school science and math teachers will be surveyed to answer the research questions. Data is in the process of being collected with a small sample already analyzed.

## **MATHEMATICS TEACHERS' PROFESSIONAL GROWTH AS A RESULT OF MENTORING EARLY CAREER TEACHERS: A ROUNDTABLE DISCUSSION**

DeAnna McAleer, Montana State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps; Professional Development strategies to reduce achievement gaps; Discourse as a tool and Use of technology to reduce achievement gaps*

Abstract: eMSS is an online, content specific mentoring program for middle and high school mathematics and science teachers primarily from hard to staff schools. The eMSS curriculum encourages mentees and mentors to engage in reflective dialogue around disciplinary and pedagogical content knowledge with the goal of helping participants to move their practice forward. Although eMSS was designed to support beginning mathematics and science teachers, I have observed through reading dialogue and interacting with participants that the mentor teachers have benefited professionally from the program as well. I am currently in the initial stages of designing a study to investigate the mathematics mentor teachers' professional growth as a result of participating in the eMSS program. The purpose of this session is to gather ideas and feedback about potential research questions and methodology for this study. Specifically, I would like comments and advice regarding the following questions:

- 1) How can I narrow down this topic to address several specific research questions to form a cohesive study?
- 2) How is professional growth in mathematics teaching defined?
- 3) What data can and should be gathered to evidence professional growth and should the evidence be from the researcher's or the practitioner's perspective?
- 4) How can I connect this study to the CLTW research goals?

## **THE DEVELOPMENT OF A SUSTAINABLE, HIGH QUALITY PROFESSIONAL DEVELOPMENT MODEL FOR THE CLTW FACULTY – A ROUNDTABLE DISCUSSION**

Alyson Mike, Montana State University Doctoral Fellow

*Theme V: Research on Connections between Program Evaluation, Public Policy and Achievement gaps*

Abstract: The purpose of the study will focus on designing of a high quality and sustainable professional development for faculty of the CLTW courses. The study will examine the effects of the intervention that focuses on promoting and furthering effective online instruction. The professional development will focus on what are considered essential components for best practice in online courses including facilitating dialogue, as well as examining online course design and organization [syllabus] and interaction between faculty and students. In addition, the CLTW course summative evaluation will be used to help guide the professional development.

The initial design of the professional development consists of a two-week on line component with a sustainable element that occurs during the fall semester. The intent is to initiate a design that can be further developed and utilized within the CLTW framework. A professional development program that allows faculty to work together to improve practice can move toward meeting student expectations by establishing some consistency in all courses.

### Roundtable Discussion Questions:

- What research methodology would best evaluate and determine effectiveness of the professional development
- What would the ongoing piece look like, i.e. how could coaching, modeling of best practices be used within the course offered that promotes best practice but is an efficient use of faculty time?
- What part of the online courses would be beneficial for students if it were standardized, i.e. homepage layout, desktop appearance, where to find information, etc.

## **PRE-SERVICE TEACHER EXPERIENCES IN MULTICULTURAL SETTING**

Zoe Mohesky, M. Ed., University of Montana Masters Fellow (*not presenting*)

Georgia Cobbs, Ph.D., University of Montana Co-PI and Research Faculty

*Theme III Culture & Learning: Connection between culture & learning for students from diverse groups*

Abstract: To determine the benefits of an introductory field experience immersion course for 21 pre-service teachers (PTs), an intensive two-week course took place in classrooms (grades 5 - 12) on the Flathead Indian Reservation during three winter sessions. Using qualitative data collected from the PTs' journal entries, themes emerged pertaining to the teaching profession, classroom management, special needs, and diversity.

## **DEVELOPING A PROFESSIONAL LEARNING COMMUNITY AMONG MATHEMATICS TEACHERS ON TWO MONTANA INDIAN RESERVATIONS**

Karma Nelson, Montana State University Doctoral Fellow and Professional Development Teacher Leader

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Professional Development strategies*

Abstract: This study documents the development of a professional learning community [Math Inquiry Group] of mathematics teachers from schools on or near the Crow and Northern Cheyenne reservations in Southeast Montana (referred to in this study as the bounded system) using an approach referred to as ALRR (Ask, Listen, Respond and Reflect). It adds to the current body of literature identifying professional learning communities as a recommended method to improve classroom practice and close achievement gaps in mathematics. Although much has been written about professional learning communities within a given school or district, there is little advice for those wishing to develop a professional learning community across schools.

Teachers and administrators in the bounded system were committed to improving student learning in mathematics but struggled to do so within the context of high student mobility rates and a serious lack of consistent curricular material. The use of ALRR helped establish a spirit of trust among Math Inquiry Group [MIG] participants while responding to important contextual factors. The identified contextual factors were organized around three themes: organizational, family and community, and policy factors.

Twenty-three mathematics teachers from grades 5-12 were interviewed about their participation in the professional learning community known as MIG over a three-year period. The researcher's analysis of the interview transcripts indicates teacher participation in MIG addressed their professional, intellectual, emotional, and personal needs. Teachers also identified an increase in personal content and pedagogical knowledge of mathematics and an increased self-confidence in their ability to teach the content. These in turn influenced their classroom practice. Through the process, teachers began to change their sense of professional identity.

**A SYSTEMATIC MAPPING REVIEW OF INTERVENTIONS IN SECONDARY MATHEMATICS WITH AT-RISK STUDENTS: INSTRUCTIONAL INTERVENTIONS – COOPERATIVE LEARNING**

Jerry Overmyer, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps and Theme I Defining/Understanding Critical Dimensions of Achievement Gaps*

Abstract: This presentation summarizes data on pedagogical/instructional interventions in cooperative learning strategies. The overall study goal was to identify interventions most effective for improving mathematics achievement while reducing the achievement gap. This intervention was supported by ten empirical studies with nine of the ten yielding positive effect size estimates.

Summary: Following the information presented on the systematic review overview, this presentation focuses on the usage of cooperative learning as a pedagogical or instructional intervention in mathematics with at-risk students. Background information, including a summary of previously published systematic reviews on cooperative learning, along with the preliminary results of this intervention summary, will be presented.

Comparisons of effect size estimates of two disadvantaged at-risk factors (female gender and low-academic achievement) are made with the main effect size estimates. Mixed results are

noted for the use of cooperative learning as a pedagogical or instructional intervention for females and for students of low-academic achievement.

## **A SYSTEMATIC MAPPING REVIEW OF INTERVENTIONS IN SECONDARY MATHEMATICS WITH AT-RISK STUDENTS: INSTRUCTIONAL INTERVENTIONS – COGNITIVE/METACOGNITIVE STRATEGIES**

Shelly Parsons, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps and Theme I Defining/Understanding Critical Dimensions of Achievement Gaps*

**Abstract:** This presentation summarizes data on pedagogical/instructional interventions in cognitive and metacognitive strategies. The overall study goal was to identify interventions most effective for improving mathematics achievement while reducing the achievement gap. This intervention was supported by fourteen empirical studies with thirteen of the fourteen yielding positive effect size estimates.

**Summary:** Following the information presented on the systematic review overview, this presentation focuses on the teaching of cognitive and metacognitive strategies as a pedagogical or instructional intervention in mathematics with at-risk students. Background information, including a summary of previously published systematic reviews on cognitive and metacognitive studies, along with the preliminary results of this intervention summary, will be presented. Comparisons of effect size estimates of two disadvantaged at-risk factors (female gender and low-academic achievement) are made with the main effect size estimates. Results show that the teaching of cognitive and metacognitive strategies as an intervention favors females but does not favor students of low-academic achievement.

## **METACOGNITION AND A LEARNING PORTFOLIO AS A TEACHING TOOL: WHAT ARE THEY THINKING AND HOW DO WE KNOW?**

Shelly Parsons, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Discourse as a tool to reduce achievement gaps and Theme IV: Research on Connections between assessment strategies and achievement gaps*

**Abstract:** By using multiple methods of assessment such as: portfolios, performance based assessments, projects, group and individual problem solving activities, and journal writing, the learning journey over a period of time can be evaluated. Opportunities of self-reflection and assessment are provided to the learner. Self reflection and assessment are learning to monitor and control one's own thinking processes. These are complex skills to learn.

Metacognition is defined as "one's knowledge concerning one's own cognitive processes and products or anything related to them (Nitko, 2004). The idea of metacognition requires active monitoring and continual attention be applied to these processes. When students are aware of their thoughts about learning activities, they can use this awareness to control their learning processes. Thus portfolio assessments are a unique way to focus attention on metacognition.

Join me as I take you on a journey of student learning with the elements and application of a Learning Portfolio in mathematics courses. I will share examples of student discussions and personal reflections that demonstrate growth as a learner of mathematics and as a lifelong

learner. I will share the evolution of my version of a Learning Portfolio over the last 5 years in courses like Elementary Statistics, College Algebra, Trigonometry, and Calculus.

### **“WHAT WOULD VYGOTSKY DO?” AN EVALUATION OF MIDDLE SCHOOL SCIENCE PROFESSIONAL DEVELOPMENT**

Barbara Patterson, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Professional Development strategies; Theme III Culture and Learning: Professional Development on culture and learning*

Abstract: To improve science literacy we need to improve a teacher’s ability to teach science. This paper attempts to connect standards and research on science teacher preparation with Vygotskian theories. Teacher survey results from the Center for Learning and Teaching in the West (CLTW) are examined to determine if strategies modeled and offered at these workshops integrate theories of Lev Vygotsky. Vygotsky's theory of education can and should be applied to science teacher education. Colorado State University has offered professional development workshop for teachers for four years from 2002 – 2006. The focus of the CLTW training included workshops in pedagogy, content, technology and diversity. The teachers completed a survey at the completion of each institute. The focus of this study was to code responses from the survey that answered the question: *Describe how your students benefited from your CLTW professional development experience.*

In addition, I am doing a case study of one of the middle schools that participated in the program. I have done class observation of science concepts using different teaching strategies modeled in the CLTS workshops. ns and will code students’ responses from benchmark tests trying to uncover their understanding

### **WHAT IS CULTURALLY RELEVANT? CULTURALLY VALID CURRICULUM AND ASSESSMENT FOR LOW-INCOME HISPANIC STUDENTS.**

Barbara Patterson, Colorado State University Doctoral Fellow

*Theme III Culture and Learning: Connection between culture and learning for students from diverse groups and Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Broad curricular, scheduling & structural changes to reduce achievement gaps*

Abstract: A broader understanding of the cultural value systems in which children grow up is necessary to improve the education of minority students (Trumbull, Greenfield, Quiroz, 1996). Data indicates that Hispanic students in the United States have the largest achievement gap in science and the trend indicates that this gap is increasing. Relevant curriculum and authentic assessment is necessary because culturally and linguistically diverse students learn in culture specific ways. In order to do this, teachers must create inclusive classroom cultures that embrace multiple ways of knowing. In science, it is important that students become connected to the environment in which they live to understand these natural processes around them. The aim of this study is to uncover what the cultural beliefs and attitudes are in Mexican-American students and apply these values to the science classroom in an outdoor field setting.

The program “Birds beyond Borders” (BBB), coordinated by the Rocky Mountain Bird Observatory (RMBO), connects students from Colorado with Michoacan, Mexico. Letters exchanged in this program will be used as documents to learn about students’ values. Data will

also be collected through classroom and field observations in these two locations. Using a curriculum that is culturally sensitive and engages students in their learning, students will participate in an environmental education experience banding birds and studying bird migrations in a field setting. This study will focus on what the beliefs and values are for these students in our science classes today. Defining what culturally relevant means can improve achievement in science classes for low-income Hispanic students.

### **USING SMART BOARD TECHNOLOGY TO LEARN ALGEBRAIC CONCEPTS.**

Karen Peterson, University of Montana Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps; Theme III Culture and Learning; Theme IV Research on Connections between Assessment Strategies and Achievement Gaps*

**Abstract:** This research focused on student's motivation, engaged time, and conceptual processing to learn algebraic concepts using smart board technology. This study is in response to an ongoing problem with students living in the 21 century being hypertext minded and unmotivated and disengaged by traditional pedagogy. Data will be collected randomly from two fifth grades classes at Hellgate Elementary, Missoula Montana. Both classes represent a closely matched teaching style, teaching experience and environment. Two classes will be used as it represents a better distribution of the population of students in the district. The classes will be divided randomly to determine a control group and experimental group, stratified to match the unique cultural backgrounds; Among, Native Americans, Russians, African American and Anglos represented at Hellgate Elementary. The control class will be taught the beginning algebraic concepts with a hands-on kit and no technology while the experimental group will be taught using smart board technology, manipulating the pawns, scale etc. The method of assessing student's motivation will be done by formal observations of motivation, time on task, and students work, which includes computations, and constructed response questions. Results of the study will show that the use of smart boards will increase motivation, engaged time and conceptual processing of algebraic concepts introduced in fifth grade.

### **INSTRUCTIONAL INTERVENTIONS AND THE ACHIEVEMENT GAP IN SCIENCE**

Chris Romero, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Other standards- and research-supported strategies to reduce achievement gaps; Broad curricular, scheduling and structural changes to reduce achievement gaps*

**Abstract:** The achievement gap in science between mainstream and nonmainstream students in schools in the United States is well-documented. Factors contributing to this gap are complex and multi-faceted, including socioeconomics and language of the students, and curriculum, and pedagogy, to name a few. The purpose of this paper is to analyze existing research on instructional interventions that have an impact on the achievement gap in science between mainstream and nonmainstream students. One instructional intervention, cooperative learning, will be addressed in this paper. The methodology in this paper involves literature review and synthesis. For research studies conducted since 1980, evidence has been reported that supports the notion that cooperative learning activities improve science achievement for nonmainstream students and in some cases, close the achievement gap. Despite these findings,

more research on the impact of cooperative learning on the science achievement needs to be undertaken to provide a larger and deeper research base from which to base education policy, professional development and teacher training focused on narrowing the achievement gap.

## **MULTICULTURAL EDUCATION IN PRESERVICE AND INSERVICE TEACHER TRAINING PROGRAMS**

**Chris Romero**, Colorado State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Preservice Preparation strategies to reduce achievement gaps; Professional Development strategies to reduce achievement gaps; Broad curricular, scheduling and structural changes to reduce achievement gaps*

Abstract: The achievement gap in science between mainstream and nonmainstream students in schools in the United States is well-documented. Factors contributing to this gap are complex and multi-faceted, including socioeconomics and language of the students, and curriculum, and pedagogy, to name a few. A number of researchers and authors have indicated that teacher attitudes toward and expectations of diverse students often impact the achievement of these students. The purpose of this paper is to identify and describe preservice and inservice teacher training programs that impact teacher attitudes toward diverse students different from themselves. The methodology in this paper involves literature review and synthesis. For research studies conducted since 1980, evidence has been reported that supports the notion that multicultural education programs have an impact on teacher attitudes toward diverse students. However, many of the studies are qualitative in methodology and involve small samples, so generalization to a larger population is suspect. Future research in this area should focus on quantitative methods that can allow analysis of these types of programs on a larger scale and provide for generalization to a larger population in order to determine their efficacy.

## **MASTERY OF RATIONAL NUMBERS: A CONNECTION AND GATEWAY TO HIGHER MATHEMATICS**

**Rena Seegmiller**, University of Montana Doctoral Fellow

*Theme I Defining/Understanding Critical Dimensions of Achievement Gaps; Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Other standards- and research-supported strategies to reduce achievement gaps*

Abstract: Mastery of rational numbers, especially fractions, is often considered an important gateway for secondary students before progressing to higher mathematical concepts such as algebra and trigonometry. Many students find themselves unable to progress because they cannot demonstrate mastery of rational number operations. Conceptual understanding of money as a symbolic form of rational numbers is part of secondary students' prior knowledge due to their need to work with money. For low achieving high school students, this knowledge does not connect with rational number understanding. Reasons for this disconnect may include the inability to express fractions whose denominators are not factors of the powers of ten as decimal fractions, the concrete nature of the coins and bills versus fractional notation, lack of understanding of the proportional relationship of numbers, or an inability to know what type of operation is required for a problem. This qualitative research will examine students' prior knowledge of problems involving money, how students think about and solve money problems,

what understanding students do have of fractional notation and problems, what misconceptions students have of the connection between money and rational numbers, and how students can use their street knowledge of money to progress to higher mathematics.

## **THE BENEFITS OF ACTION RESEARCH AND ITS IMPACT ON CLASSROOM TEACHING PRACTICE**

Sarah Segal, Montana State University Doctoral Fellow

*Theme VI: Research on Leadership Development in STEM Education*

**Abstract:** Action research is a methodology that appears to be valuable as a problem solving tool. For the teacher in the classroom it can provide opportunities for reflection and improvement, a testing ground for improving the teacher's practice. Action research is also seen as a personal transformational tool for those who implement it accordingly. The purpose of this study is to better understand these claims about the benefits of action research. Several questions stand out as one delves into such an investigation: How is action research used by teachers? Is it found to be beneficial, practical, and a valid research tool by teachers who use it? Are teachers able to continue to practice action research if they have found it to be worthwhile? And, what kind of change has been initiated for teachers in their careers?

For the past five years teachers completing masters degrees in mathematics education at Montana State University - Bozeman (MSU) have been required to conduct an action research project, referred to as their "capstone project." Approximately fifty teachers have completed or are currently completing these projects. I propose to work with this group of teachers through survey's and interviews, while also examining the action research, capstone project they did. The extent to which their action research project impacted their practice has never been investigated.

## **ABSENTEEISM IN AT-RISK, POST-SECONDARY STUDENTS, THE IMPACT OF PROVIDING COURSE LECTURE NOTES ELECTRONICALLY.**

Richard K. Stiff, University of Montana Doctoral Fellow at Chief Dull Knife College

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Other standards- and research-supported strategies to reduce achievement gaps; Use of technology to reduce achievement gaps*

**Abstract:** The purpose of this study is to weigh the impact of providing access to lecture notes electronically, on the attendance of students in Science courses at Chief Dull Knife College. Reservation schools are noted for high rates of absenteeism (Chavers, 2002; Rousey & Longie, 2001; Nelson, 2003), and while providing notes outside of class will aid students that miss lectures, having access to these notes may also increase absenteeism. In this study a comparison of attendance habits of Science majors and non-majors will be made as well as those taking freshman level courses and sophomore level courses. This is a mixed methods study using attendance data from courses, and questionnaires about attendance. The classes themselves will serve as both treatment and control for the study. Studies at traditional campuses have demonstrated an increase in absenteeism (Grabe, 2004), but those that missed class and utilized demonstrated no drop in scores when compared to those that attended class (Kiewra, 1985). Studies such as these have not been done with the non-traditional students associated with tribal colleges (Rousey & Longie, 2001). These students tend to be in their late 20's, and are often at the seventh or eighth grade level upon high school graduation (Rousey & Longie, 2001).

## **THE EFFECT OF FACILITATOR TRAINING ON THE DEVELOPMENT AND PRACTICE OF PARTICIPANTS IN AN ONLINE INDUCTION PROGRAM FOR TEACHERS OF SCIENCE AND MATHEMATICS**

Peggy Sue Taylor, Montana State University Doctoral Fellow

*Theme VI Research on Leadership Development in STEM Education*

Abstract: Learning in computer-mediated conferencing systems requires frequent and open interaction in environments that foster sharing and examination of group knowledge and experiences. Written dialogue is the means by which this interaction takes place. This study examined the effects of a training program designed for facilitators in the e-Mentoring for Student Success (eMSS) program, which provides online induction for beginning science and mathematics teachers. The training was designed to improve the quality of dialogue among participants in the program. The intervention consisted of three components: 1) an online training institute prior to beginning of the program year, 2) placement of facilitators in positions within the discussion areas of the program, and 3) ongoing online support for practicing facilitators.

Three examinations were conducted in this mixed-method study. First, preintervention program dialogue was quantitatively compared to post-intervention program dialogue through use of a program-specific rubric to code program discussions. Second, case studies were conducted to determine how the training affected the practices of seven program facilitators and which components of the training effected change or growth. Third, pre and post intervention surveys were administered to all participants of the training to obtain their perceptions of their development as a result of the intervention. Comparison of dialogue before and after the intervention indicated a significant improvement in dialogue quality in the discussion areas of the program. Case studies of facilitators' practices revealed areas of the training that impacted the skills and strategies that facilitators used in efforts to foster increased and improved dialogue. Survey results indicated that participants gained a better understanding of what constituted quality dialogue in terms of the eMSS program and how better to foster quality dialogue in an online environment. Components of the training found to be effective in helping facilitators to foster dialogue improvement were: 1) focus on program goals and vision, 2) focus on the nature of online communication, 3) practice with the analysis of actual program dialogue, 4) practice in composing effective online messages. Implications for online facilitators are discussed and recommendations are made for designing training for facilitators to work in computer-mediated conferences.

## **TEACHERS' BELIEFS AND RESEARCH FINDINGS ON EFFECTIVE TEACHING STRATEGIES FOR AMERICAN INDIANS IN MATHEMATICS**

Raquel Vallines Mira, Montana State University Doctoral Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Other standards- and research-supported strategies to reduce achievement gaps and Theme III Culture and Learning: Connection between culture and learning for students from diverse groups*

Abstract: Extensive research has been done regarding effective teaching strategies for American Indian students in mathematics. Several teaching strategies have been identified by research as effective for teaching mathematics to American Indian students. Not many of those studies, if any, has been done by asking teachers what their experience has taught them about

what teaching strategies are more effective for their American Indian students learning of mathematics. The main purpose of the study I am proposing is to add the voices of four dedicated teachers (Indian and non-Indian) to the conversation about effective strategies for American Indians in mathematics. I intend to do this by identifying the beliefs of four dedicated teachers with particular focus on three teaching strategies (contextualized Instruction, teaching through modeling, and joint productive activity) while giving them the chance to also express their views about other practices that may be of importance to them. The teachers involved in this study are dedicated in their efforts to reach American Indian students in mathematics and have been attending professional development activities on a regular basis in which they reflect upon their students' learning. These teachers are exemplary dedicated teachers who are deeply concerned about their students learning. I want to learn from them and I want their voices to be heard.

The research design is qualitative and uses a combination of methodologies including classroom observations and a modification of videoclip interviews (Speer 2001) as a way of studying teachers' beliefs on effective teaching strategies for American Indian students in mathematics.

## **SOCIAL NETWORKING TECHNOLOGY HELPS TO CLOSE THE ACHIEVEMENT GAP FOR NATIVE AMERICAN STUDENTS**

Diane Woodard, University of Montana Masters Fellow

*Theme II Teaching and Learning Approaches to Reduce Achievement Gaps: Use of technology to reduce achievement gaps; Preservice Preparation strategies to reduce achievement gaps*

Abstract: This study looks at the use of social networking technology, such as MySpace, to reduce achievement gaps. The question that I am interested in is, how can we use the social networking technologies that are engaging students across the nation for hours each day, in education? Specifically, I would like to see if setting up a virtual social environment, similar to MySpace, could increase engagement in academics, and therefore reduce achievement gaps for native American students in Montana. The virtual environment will be created to model the native American culture and provide on-line activities that enhance the existing curriculum. Other social networking tools such as text messaging, chatting, social bookmarking etc. will be used in the virtual space.

The timeline for the project would be the first semester of the 07-08 school year. I am interested in looking at a classroom in Arlee, Montana. Tammy Elser, who is the lead in the state on Indian Education for All, would serve as a mentor to the project to ensure that we are aligning the virtual environment to the cultural environment. She will also assist with assessment of the project. Upon completion of the observations and evaluation I will create a unit to use with pre-service teachers to help them understand the impact that social networking is having upon students. Specifically, I am interested in determining if this virtual environment might help in closing the achievement gap for Native American students. One question I have as I approach this study is, are there gender differences in the use of tools such as MySpace? The statistics show that females are engaging in social networking technologies more than males. I do not know if this will have an effect on my study.