

**Summary of Aurora University Summer Institute in  
Mathematics for Elementary Teachers**

**WIP 2 Year 1**

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**Introduction:** Aurora University (AU) and its educational and community partners collaboratively developed a Summer Institute Program in Mathematics for Elementary Teachers. This program was designed to meet the goals of the Illinois Mathematics and Science Program (IMSP) for improving the teaching of mathematics to elementary teachers in high needs school districts. Along with Aurora University, partners include Illinois Mathematics and Science Academy (IMSA), Robert Crown Center for Health Education, Packer Foundation Center for Applications Based Learning, and DuPage Children’s Museum (DCM), Plano Community School District 88, Carpentersville Community Unit School District 300, East Aurora District 131, West Aurora District 129, Indian Prairie District 204, and Oswego Community Unit School District 308.

**Overview:** The AU Summer Institute in Mathematics for Elementary Teachers is designed as a three-week immersion into the teaching and learning of mathematics, offered for graduate credit to elementary teachers of grades three to five in the participating districts. This workshop in mathematics with science connections will include instruction on problem-based learning (PBL). University faculty will deliver instruction in content-area curriculum and familiarize the participants with action research. The mathematicians, scientists and engineers among the collaborative partners will provide on-site, real world applications of mathematics and science. The workshop will have a strong practice base aligned to the mathematics curriculum and taught with a hands-on, inquiry based focus. Each day of the workshop will include time for discussion of how to apply what has been learned, as well as an opportunity for written reflection.

Theory and practice will be woven together in a rich classroom environment for teaching mathematics. The university will equip classrooms with cutting edge technology and resources. The creation of this environment is important to the success of the program because of the integration of mathematics content, hands-on use of tools, equipment, technology, and will provide opportunities for reflection and practice.

The focus of the evaluation is meeting the IMSP project outcomes, which are based on professional development outcomes articulated by the Council of Chief State School Officers. These are:

- Quality of Professional Development
- Change in Teacher Content Knowledge
- Change in Instructional Practices
- Student Achievement
- Sustained Administrative Support

**Goal of the Summer Institute Program in Mathematics for Elementary Teachers:**

- Deepen teacher-participants’ content knowledge
- Expand pedagogical knowledge
- Improve student mathematic achievement
- Integrate problem-based learning in mathematic instruction

**Workshops included the following topics:**

- Introduction to problem-based learning (PBL) and the nature of scientific inquiry
- Mathematics K-12 curriculum scope and sequence
- Problem solving to explain connections between mathematics and real world problems
- Mathematics in aeronautical engineering
- Math applications found in health curriculum
- Content instruction in teaching numbers and operations, algebra, geometry and data analysis
- Mathematics inquiry and explorations
- Action based research
- Problem-based learning
- Inquiry-based teaching and learning
- Incorporating technology to enhance mathematical instruction and understanding

**Program Design:** This program used a one-group pre-test post-test design, with a mixed-method approach representing both qualitative and quantitative components.

**Participants:** Twelve teachers from two school districts participated in the program. DTAMS test results provided scores for twelve teacher-participants. Teacher-participants were all elementary math teachers in grades three to five and from the following school districts: Plano Community School District 88, Carpentersville Community Unit School District 300, East Aurora District 131, West Aurora District 129, Indian Prairie District 204, and Oswego Community Unit School District 308. It should be noted that a second session of this mathematics program took place in September 2011. The additional sixteen teacher-participants from that session will be added to the group of twelve for the 2011 summer workshops. The total number will be twenty-eight for summer 2011. The results of this report will only be of the twelve teacher-participants.

**This report is a summary of a three-week intensive immersion in problem-based learning (PBL) in mathematics and reflects results of the program thus far.**

**Quantitative Data Collection and Findings at this Stage:****Diagnostic Teacher Assessments in Math and Science (DTAMS) pre/post tests:**

These tests were used to assess teachers' content knowledge in mathematics. DTAMS were given at the beginning and end of the three week workshop with scores analyzed for increase in content knowledge. The mathematics assessments measured four areas: memorization and factual design, conceptual understanding, reasoning and problem-solving, and pedagogical content knowledge. This *DTAMS* assessment for mathematics teachers developed by the University of Louisville, Center for Research in Mathematics and Science Teacher Development will be used to assess teachers' content knowledge in mathematics. Participants will be tested at the beginning of each summer program and the end of the second academic year.

**Findings:**

**CCSSO Matrix Outcome B (Changes in Teacher-participant Knowledge)**

**DTAMS** – Cronbach’s Alpha was calculated for pre test and post test

**Rational Numbers**

Pretest Mean	Pretest SD	Range-low	Range-high	Pretest N	Pretest Missing
31.8	5.5	24	40	12	0
Post Mean	Post SD	Range-low	Range-high	Post N	Post Missing
33.4	6.5	21	39	11	1

Pretest reliability = 0.84      Posttest reliability = 0.84      Pearson = 0.5

\* Analysis of individual scores indicates that 7 of 11 teacher-participants showed gains in pedagogical content knowledge after the two-week workshop.

**Whole Numbers and Computation**

Pretest Mean	Pretest SD	Range-low	Range-high	Pretest N	Pretest Missing
28.8	6.62	16	38	12	0
Post Mean	Post SD	Range-low	Range-high	Post N	Post Missing
33.4	3.4	26	39	12	0

Pretest reliability = 0.8      Posttest reliability = 0.5      Pearson = 0.78

\*Analysis of individual scores indicate that 12 of 12 teacher participants showed gains in Pedagogical content knowledge after the three-week workshop.

**Survey of Enacted Curriculum (SEC):** This assessment was given at the beginning of the workshop to provide a baseline for comparison. A second SEC will be administered again at the beginning of the 2011 Summer Institute. These data will be used to identify changes in practices from year to year among teacher-participants. It is expected that the teacher-participants’ practices will include increased evidence of effective instructional practices. Additionally, SEC data will give indications of participants’ curriculum alignment with state goals targeted by the program.

**Findings:**

**CCSSO A (Quality of Professional Development Activity) Course evaluations for course design, content, and instructional materials.**

	<b>Very Low</b>	<b>Low</b>	<b>Average</b>	<b>High</b>	<b>Very High</b>
<b>Course Design</b>	<b>0</b>	<b>8</b>	<b>6</b>	<b>25</b>	<b>61</b>
<b>Course Content</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>47</b>	<b>47</b>
<b>Instructional Materials</b>	<b>3</b>	<b>3</b>	<b>8</b>	<b>39</b>	<b>47</b>

**Reformed Teaching Observation Protocol (RTOP):** The RTOP *will be* conducted during the 2010-2011 school year by educational and community partners to gather information on context, lesson design and implementation, lesson content and classroom culture for indications of reformed teaching during the 2010-2011 school year. The RTOP was created by the Evaluation Facilitation Group of the Arizona Collaborative for Excellence in the Preparation of Teachers. Observations will be conducted at the beginning of the first academic year and end of the second academic year.

**Illinois Standards Achievement Tests (ISAT):** Mathematics scores *will be* analyzed and compared for indications of increased student achievement as a result of teacher-participant' effect on student performance. This data will be analyzed and compared from the first year to the second year. Both aggregate and individual student data provided by the participants' district office will be analyzed each year.

### **Qualitative Data Collection and Findings at this Stage:**

**Learning Experience Evaluations by Participants:** Teacher-participants recorded their detailed learning experiences through brief questionnaires and open-ended responses to provide insight into program efficacy. They will continue to record their experiences during the 2010-2011 school year as they put into practice lessons learned during the two-week program.

**Focus groups:** Focus groups of participants *will be* conducted at the end of each summer program to examine workshop quality and content knowledge.

**Surveys and Interviews of organizational leadership:** Leaders of the schools and program partners will be surveyed and interviewed. Data will be analyzed for insight into program sustainability and efficacy. Partner interviews are planned for the fall semester of 2010. A preliminary interview schedule has been developed and interviews have been identified.

**Learning Experience Reflection examples:** Data was collected through self-reported reflections and answers to survey questions. The open-ended responses of the teacher-participants provided numerous indications of enthusiasm and success. Comments from teacher-participants indicate that the workshops were successful in many respects. One teacher-participant spoke directly about working in groups. "Working with peers is extremely helpful to my professional growth." Another stated, "The opportunity to have graded math samples in groups helped validate what I do when I score my students' work. We don't always have this opportunity." Another commented, "I liked the discussion amongst the other participants. I liked hearing their rationale that led to their solutions to the problems."

With teacher content knowledge in mind, comments were made by teacher-participants regarding their interest in inquiry based teaching as a strategy to presenting content. Positive responses included, "I found that using inquiry based teaching and learning to be most valuable in the sessions." Similarly "Overall inquiry of asking 'why' without

necessarily having an answer is an activity I will use in my classroom," and finally, "I like the idea of inquiry and developing that idea because students become thinkers. I just wish there would have been examples of how to do an inquiry based teaching at my grade level."

Hopeful statements emerged about increasing academic achievement of the students. One such response includes, "I will try to find problems that will engage my students and encourage them to work together to gain confidence". Another such comment, "I want to begin designing my math units for my students today!"

Outcomes of student achievement will be assessed after the school year as teacher-participants implement content, knowledge and skills learned from their participating in the program. Many reflective comments pertained to the ideas learned from the program and how they will be utilized when teaching. References to instruction, or to a particular teacher-participant's instruction, or to a specific subject or student population, were also included in the reflective statements.

### **Program Impact:**

**Impact on Teachers:** At this stage of the program, data is limited to pre and post-tests (DTAMS), and reflective learning experience summaries. Follow-up visits and site evaluations to observe teacher-participants are scheduled for the 2010-2011 school year. These visits by educational and community partners will provide support for teacher-participants as they implement strategies learned during the summer program.

**Impact on Students:** The impact on students will be assessed after the 2010-2011 school year, as the first implementation of the workshops was delivered in summer of 2010. Test scores for the coming school year will be compared to those of the previous school year.

**Impact on Instruction:** Information about instruction will be derived from the RTOP and SEC data. The RTOP data will be available as a baseline by December 2010. Changes will not be discernible until after the summer workshop of 2011, after which a post-test sample of the RTOP data will be collected. Similarly, teachers have completed pre-test SEC's, but the post-test data will not be collected until the second round of summer workshops is initiated in 2011.

**Conclusion:** The collaborative team that has developed the AU Summer Institute in Mathematics for Elementary Teachers believes that their work has resulted in an innovative professional development program that will improve the content knowledge of the participating teachers, strengthen the quality of their instruction, and promote student achievement in math in high needs school districts. The program is based on needs assessments and research achievement in math in high needs school districts. It is based on needs assessments and research into best practices for inquiry-based standards-driven instruction. It incorporates the STEM expertise of mathematicians, scientists and engineers, and a highly-regarded problem-based learning model. Assessments and evaluations are integrated as an ongoing element in the program's design and delivery.

Members of the team are pleased to have had the opportunity to work on this project and take pride in the first year's results.