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### Su Liang CD SUMMER 2011

Su Liang

CSUSB, sliang@csusb.edu

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## **Engaging Students in Learning Mathematics from Multi-dimensions**

Su Liang, Department of Mathematics, CSUSB

September 19, 2012

This course development project was designed to significantly change the traditional way (lecturing) of teaching Math 301A (the first course of Mathematics for Future Teachers). The goal of the project was to deeply engage students in learning from multi-dimensions including problem-based learning, discovering learning, peer collaborative learning, and virtual learning. "I Do, We Do, You Do" was implemented in my teaching. That says that as a teacher I provide scaffolding through explicitly teaching a new skill, walking through the new skill with my students together, and then let students work collaboratively through group activities such as discussing and solving problems together. In the classroom, students engaged in problem solving both individually and collaboratively to find the resolution for problems.

The class was structured in such a way so that the teacher minimized her lecture time to give the floor to the students, and students were the ones who talked or wrote their mathematics ideas most of the class time. Outside the classroom, Blackboard was utilized to build a virtual learning platform for students to share ideas. A typical class scenario was: 1) the teacher initiated questions closely related to certain mathematics concepts, properties, and ideas and led students to search the answers. Explicitly teaching was provided to work on new skills in order to lay a foundation for students to be able to inquiry more challenging mathematics problems. 2) After scaffolding, students worked in groups to solve some situated problems. Regularly each group had three or four students. They discussed the problem and work collaboratively to seek the solutions. Each group would write their solutions in detail on the blackboard and then explicitly share their thinking with the whole class. They would answer any questions raised by other groups or individual students. Sometimes document camera was utilized to articulate their ideas.

This course provided ample opportunities for students to communicate their mathematics ideas orally and in writing, using multiple approaches including group discussions, whole-class discussions, individual and group presentations, writing solutions or mathematics ideas on the blackboard and explaining to their peers, creating word problems and providing solutions with reasoning, using different ways to solve problems and having students teach their methods to their group or in front of the class, orally summarizing what they had learned at the end of each class, writing detailed reasoning for the answers in the quizzes or exams, and writing lesson plans (extra credit).

Outside the classroom, I used Blackboard to build a virtual learning platform which provide supplemental learning tool for students such as chat room for discussion, sharing findings on Blackboard, and summarizing knowledge learned. Manipulative such as base ten blocks, fraction strips, algebra tile were used to explore certain mathematics concepts.

This course development project has been implemented in three class sections in winter 2012 and spring 2012. The students' feedback was very positive. I would like to share some students' comments from the department survey:

- I have learned actually what things mean and why things relate instead of remembering it as just a rule. I actually have pushed my thinking to search for answers.
- I think I have learned a lot more ways and strategies to get the same answer. I feel I could explain more in depth of why math is used in certain ways.
- I enjoyed the activities and how all the students engage in the activities, I am learning from everyone else... I see a difference in myself with math, such as all the strategies I have learned.
- I grow the most in fractions and division.
- By working with others, I've gotten to learn various ways to solve a problem.
- It has given me the ability to explain how to do math problems in more than one way. It has also helped me personally to understand how to do fractions & word problems a lot better.
- It (this course) has made it easier to relate to those students who may need visual stimulation, or who just may need to see it another way.

- I have learned how to be able to think of different ways to teach certain math concepts and better understand it myself.
- I feel comfortable and confident & I had opportunity to work w/ different classmates w/ different learning styles.
- I have learned and have better understand concepts that I did not completely understand. Also (I) have learned many different ways I can teach the problems.
- I learned how to explain rather than just do the problems.
- I enjoyed using models to make learning more visual.
- This class has helped me see other views on a math problem.
- I have learned to search for the answers to why math is done a specific way. I have learned to not be intimidated and to ask my teachers and my peers to explain answers.
- I am now able to explain “why” more clearly.
- Before I would just do the questions now I am able to do the questions and fully explain what I did.
- It has enhanced my ability to teach math by understanding the reasoning behind the problems, and also by understanding how other people solve problems.
- It has helped me to be able to explain how I get answers better. I am able to explain a problem rather than just solving it.
- I have the rules of math memorized so I never gave any thought to meaning or reasoning until this class.
- It was good that it taught me how to explain math. I learned how to explain math to kids. I have a better understanding on fractions and how to teach them better.
- I have grown the most in how to explain how to solve a problem and be able to answer “why?”
- It was a good experience which made me think deeper into the math that was covered, not to just solve it but to explain why made it interesting.
- It helped me realize there is more than one way to teach math so that kids can understand.
- Class was very useful and offered out of the box thinking.
- I understand why we do certain things and how to explain it.
- There are multiple ways to explain the same topic.
- I have learned how to be able to think of different ways to teach certain math concepts and better understand it myself.
- I have learned and have better understand concepts that I did not completely understand. Also I have learned many different ways I can teach the problems.
- I learned how to explain rather than just do the problems.
- I enjoyed using models to make learning more visual.
- This class has helped me see other views on a math problem.
- I have learned to search for the answers to why math is done a specific way. I have learned to not be intimidated and to ask my teachers and my peers to explain answers.