The ELF workshop: Teachers came from different districts from around the state. The ELF workshop consisted of mathematics lessons, an opportunity to look at the New Mexico Mathematics Standards, and a chance for teachers to examine their own curriculum materials through the lens of the mathematics they were learning. The purpose of this workshop was to provide teachers with an opportunity to deepen their own mathematical knowledge for teaching as well as an opportunity to network with other teachers as well as faculty from institutions of higher education around the state.

The NMT conference: The teacher educators included university and college instructors, professional development specialists, mathematics teachers, district personnel, and the Mathematics Consultant and Bureau Chief of the Mathematics and Science Bureau from the NMPED. The purpose of this conference was to bring together teacher educators from around the state to discuss in detail what mathematics teachers need to know and how we can help them develop that knowledge. There were two overarching goals for the NMT conference:

1. To explore what it would mean for teachers to have a profound understanding of fundamental mathematics through planning, teaching, observing, and discussing three mathematics lessons.

2. To work with teachers at the ELF conference to write a position paper on pre- and in-service teacher professional development in mathematics: what are the big mathematical ideas teachers need to acquire and what experiences do they need to have in order to acquire them?

Each morning between May 30 and June 1, a teaching team from one of the three New Mexico MSP projects taught a lesson on linear functions to the ELF participants while the other NMT participants observed the lesson. The following table shows the inter-related structure of these two workshops.

<table>
<thead>
<tr>
<th>Tues, May 29</th>
<th>Wed, May 30</th>
<th>Thurs, May 31</th>
<th>Fri, June 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00-10:00</td>
<td>UNM lesson</td>
<td>NMSU lesson</td>
<td>WNMU lesson</td>
</tr>
<tr>
<td>10:00-12:00</td>
<td>Debrief</td>
<td>Debrief</td>
<td>Debrief</td>
</tr>
<tr>
<td>1:00-4:00</td>
<td>Discussed reading 1</td>
<td>NM content standards</td>
<td>Discussed reading 3</td>
</tr>
<tr>
<td>4:00-5:00</td>
<td>Plan Wed. math lesson</td>
<td>Plan Thur. math lesson</td>
<td>Plan Fri. math lesson</td>
</tr>
</tbody>
</table>

1 Both of these workshops were funded by the New Mexico Mathematics and Science Partnership Program.
2 Because there are two conferences and the participants in the conferences had different roles at different times, we will define the roles as each one is introduced. A participant who is referred to as a “teacher” is a participant in the ELF workshop. A participant who is referred to as a “teacher educator” is a participant in the NMT workshop.
The organizers, Adriana Aceves and Kristin Umland from the University of New Mexico, had attended a Preparing Mathematicians to Educate Teachers (PMET) workshop in Park City, Utah in the summer of 2005. The PMET workshop served as a basic model for the NMT workshop, although it was adapted to the specific needs of the faculty who work with elementary and middle school teachers in New Mexico.

**Tuesday, May 29:** The conference began with everyone introducing themselves and telling where they came from and why they were attending. The following charge was given to the NMT group:
- Clearly articulate our goals in teacher education
- Increase our own knowledge about mathematics teaching
- Work together to improve the teacher preparation and professional development experiences of teachers in New Mexico

The first reading was “Knowing Mathematic for Teaching” by Ball, Hill, and Bass. The participants had read the article beforehand and were assigned to discuss it in small groups. They were asked to consider the following questions:
- What are the main points of the article?
- What do the authors mean when they talk about “mathematical knowledge for teaching?”
- Based on this article, what is our responsibility as teacher educators to help teachers develop the knowledge that they need?
- How can we know whether our courses and programs for teachers ultimately benefit students?

The discussion that followed was mostly philosophical. It was agreed that teachers (and teacher educators) need both the disposition and the tools to become life-long learners. Since few come into their pre-service education courses with these attitudes and skills, it must be actively fostered in pre-service education courses. It was suggested that pre-service education courses needed to focus on the big mathematical ideas of the K-8 curriculum in order to have the time to develop these more abstract attitudes and skills. One of the organizers asked the participants to think carefully over the next few days about the following question: What are the big mathematical ideas that teachers need to understand?

**Wednesday, May 30:** The teachers arrived and were a bit shocked to learn that they would be observed by 25 people while they were trying to learn some mathematics (unfortunately, the organizers didn’t communicate this very clearly to the teachers. However, everyone stayed, perhaps because the $250 stipend looked to be worth it). Adriana Aceves and Kristin Umland taught a lesson on ratios and asked the teachers to relate them to linear functions.

The teacher educators were assigned to one of three groups during the observation of the lesson. One-third were asked to look at the mathematics of the lesson, one-third at the “teacher moves”, and one-third at student thinking. This protocol was taken directly from the PMET workshop that the organizers had attended. However, there was only a large-group discussion for the debrief, and several participants said that they thought that the debrief could have been run more effectively. In the future, we will look for different protocols for the post-lesson discussion.
During the debrief, there was quite a lot of discussion about what knowledge the teachers had brought in with them and what they did and didn’t get out of the lesson. Immediately, some differences of opinion arose about what had happened in the lesson and what it meant. One observer suggested that they were struggling with the math and instead went straight to a diagram. Another observer suggested that diagrams are mathematics. Then it was pointed out that the majority of the observers had spent most of the time clustered around the two tables that were having the most difficulty. One observer thought that the two people teaching had very different styles, while another thought they were almost identical. It was clear that we still had a lot to learn about observing and discussing a mathematics lesson. Overall, the first lesson and debrief seemed to be mostly about getting everyone oriented to the process.

The second reading was an excerpt from “Knowing and Teaching Elementary Mathematics” by Liping Ma. Everyone had read her definition of a Profound Understanding of Fundamental Mathematics (PUFM) and the conclusion of her book ahead of time. Again, everyone was assigned to a small discussion group and was asked to consider the following two questions:

• What does Ma say?
• What can you add to it/how can you expand upon it?

The discussion focused on Ma’s contention that teachers need PUFM and that in China teachers have opportunities to develop PUFM throughout their schooling and teaching careers, while in the US they do not. One of the claims that Ma makes that is most relevant to the work of the conference is that teacher pre-service education is a strategically critical period during which change can be made—as one of the participants said, “pre-service teacher education is a window of opportunity.”

Thursday, May 31: Ted Stanford and Kerry McKee from New Mexico State University taught a lesson adapted from the Connected Mathematics Program called “Painted Cubes.” Observers were more evenly distributed during this lesson. The observers who were focusing on the mathematics of the lesson commented on a greater variety of mathematics than they had on the first day. One observer said he had seen some abstraction while another thought that the teachers had been more concrete. Several people thought that the teachers had been very frustrated, but others just saw deep thinking and productive discussion between the teachers. One of the instructors commented that he was having difficulty deciding whether the teachers were frustrated or just lost in deep thought. One observer asked, “When do you decide that enough is enough?” An instructor replied that if they aren’t ready for the information, then either you are giving them extraneous information or they think their work is all bad. Another observer said she saw a lot of progress from the first to the second day. One of the instructors pointed out that the elementary teachers all drew bar graphs because that is what they teach their kids, and that this informs us about what we teach elementary teachers so they help prepare kids for middle school.

The third reading was from the Mathematical Education of Teachers published by the Conference Board of Mathematics. Again the participants were asked to discuss the document in

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3 “Observer” refers to an NMT participant who is observing the lessons that day.
4 “Instructor” refers to the NMT participant that is teaching the lesson that day.
small groups, and they were asked to come up with the main points of the article and at most five big ideas in mathematics for pre-service teacher education courses. After coming together again, the participants suggested a long list of big ideas. In the evening the conference organizers tried to organize the suggestions of the participants. This outline was used as a staring point for discussion with the teachers on the following day.

**Friday, June 1:** Tom Gruszka and Linda Beattie from Western New Mexico University taught a lesson called “Reading Problems.” On this day, the teachers and teacher educators debriefed together. The teachers got to see what the observers had been asked to look at and the teacher educators got to hear from the teachers what it felt like to be observed as well as what they had gotten out of the lessons. They were very honest about what had worked and had not worked for them during the workshop. One teacher said, “You do have certain students who do need validation. To ask a question and be told, ‘figure it out,’ that drove me insane. I stopped asking because I knew I wouldn’t get an answer. Then today it made me so happy when I got an answer—I thought, ‘all right!’” The teacher educators also got to hear about the teachers’ experiences from the whole workshop (it was revealed that they had been referring to the teacher-educators as “the dark side”). The teachers were very thoughtful and reflective about their experiences and the insights they had gained about themselves and each other. One teacher said, “When we talked we reflected on our mathematical background. Oh my god, do I have a lot to learn, a lot of changes to make. Of all the conferences I’ve been to this is the best for me. Have I been holding my kids back? It was uncomfortable, but given the time I was able to learn.”

After lunch everyone discussed the outline that had been put together the day before, and the teachers got a chance to comment on and add to it. The final draft outline that had been written by the end of the conference is contained in the final three pages of this document. In the next couple of months a writing team of six people, including two from the four-year institutions, one from a two-year institution, a person from one of the districts and two teachers will meet to organize and fill in the outline that was started at the conference.

Before the participants left, they were asked to fill out an evaluation for the conference. Select comments from the NMT included:

- It was nice to collaborate with everyone that had a common goal of improving math education. I hope that our document “goes somewhere.”
- It would have been nice to spend more time with the teachers.
- The workshop was probably the best organized, most useful and most enlightening meeting of its kind that I have ever attended.
- I liked being exposed to the fact that persons/professionals in higher education are interested in learning how they can improve math teacher-prep programs.

There were no negative comments, but there were some suggestions for how to improve the conference. Most often it was suggested that the observers needed more guidance in observing and that the debriefings needed to be structured better. One participant in particular comment on the fact that he believed he need an opportunity to improve his own skills in observing and discussing teaching.
Select comments from the ELF included:

- [The goals of the workshop were met], but there is need for continued connection, communication, meetings.
- [I have a] newfound respect for peers, both teachers and “the dark side :)”
- [There should be] more opportunities for all “sides” to meet.
- Continue working with us – to improve our teaching.
- There should be more [workshops like this one]. Continue connections of different institutions/educators at all levels.

Again, there were no negative comments, but the teachers indicated it would have helped if they had had a better understanding of what was going to happen at the workshop when they arrived.