Kansas Board of Regents
No Child Left Behind Improving Teacher Quality Grants

Performance Report

Project Director
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Project Title: Modeling Instruction Institute

Institution: Fort Hays State University and Emporia State University

Project Period: July 1, 2011- June 30, 2012

Faculty with Major Roles:
Dr. Paul Adams, Fort Hays State University, College of Education and Technology, Professor of Physics
Dr. Malonne Davies, Emporia State University, College of Liberal Arts and Sciences, Chemistry Department
Dr. Kayvan Aflatooni, Fort Hays State University, College of Arts and Sciences, Physics Department
Mr. Earl Legleiter, Modeling Consultant
Ms. Penny Blue, High School Teacher in Physics Modeling
Mr. Alan Vancil, High School Teacher in Chemistry Modeling
Dr. Beth Walizer, Fort Hays State University, College of Education and Technology, Teacher Education Department

PHYSICS PARTICIPANTS				
Timothy Kearney	Jeanine Lytton	William White	Elizabeth Peyser	Philip Swindler-2nd semester
David Leib	Winefredo Fulgueras	Edward Pokorski	Donald Mollecker	Joe Conner-2nd semester
Todd Petersen	Cody Kitzke	Kara Luce	Brandi Schottel	Arthur Ballos-2nd semester
Anna Lenhart Murray	Eryn Norton	Haley B. Gordon	Tim Blankenship	James Burk-2nd semester
Dayton Arvidson	Luke Smith	Tracie Schroeder	Gail Anne Aurand-2nd semester	Curt Parry-2nd semester

Semester: First (18), Second (6)
Gender: Female (8), Male (16), Not Disclosed (0)
Ethnic: White Caucasian (22), Asian (2), Hispanic (0), African American (0), Not Disclosed (0)
Area: Urban (8), Suburban (2), Rural (14), Not Disclosed (0)

Grade/Subject:

TEACHING SUBJECT	GRADE LEVEL	NUMBER OF PARTICIPANTS	TEACHING SUBJECT	GRADE LEVEL	NUMBER OF PARTICIPANTS
Algebra II	**6-12**	**2**	General Science	**9-12**	**2**
Biology	**6-8**	**2**	Ocean Science	**10-12**	**1**
Biology	**9-12**	**2**	Mathematics	**6-12**	**6**
Advanced Biology	**11-12**	**1**	Pre Engineering	**9-12**	**1**
Calculus	**6-12**	**1**	Physical Science	**6-8**	**2**
Pre-Calculus	**6-12**	**1**	Physical Science	**9-12**	**2**
Chemistry	**6-8**	**2**	Physics	**9-12**	**14**
Chemistry	**9-12**	**7**	Meteorology	**10-12**	**1**
Earth/Space Science	**6-12**	**7**	Robotics	**10-12**	**1**
General Science	**6-8**	6			

Area of Certification:

CERTIFICATION	NUMBER OF PARTICIPANTS	CERTIFICATION	NUMBER OF PARTICIPANTS
Physics (Grades 9-12)		Chemistry (Grades 9-12)	
Earth Science (Grades 9-12)			

Highly Qualified Area:

CERTIFICATION	NUMBER OF PARTICIPANTS	CERTIFICATION	NUMBER OF PARTICIPANTS
9-12 Algebra	2	9-12 General Science	3
6-8 Biology	2	9-12 Ocean Science	1
9-12 Biology	4	7-12 Mathematics	6
11-12 Advanced Biology	1	9-12 Pre Engineering	1
9-12 Calculus	1	5-8 Physical Science	1
9-12 Pre-Calculus	1	9-12 Physical Science	2
6-8 Chemistry	1	9-12 Physics	10
9-12 Chemistry	5	6-8 Technology	1
6-12 Earth & Space Science	6	9-12 Meteorology	1
5-8 General Science	7		

Number of Schools Served: (23)
Number of School Districts Served: (14)

School Districts:

USD	School
205	Bluestem High School
232	DeSoto High School
259	Wichita Public Schools
	Wichita High School West
	Wichita High School East
	Metro Boulevard Alternative High School
	Pleasant Valley Middle School (2)
	Hadley Middle School
	Truesdell Middle School
	Marshall Middle School
334	Miltonvale High School
343	Perry-LeCompton High School
353	Wellington High School
393	Solomon High School

595 LaCrosse Middle School/High School
397 Centre K-12 Middle School
402 Augusta High School
408 Marion High School
417 Council Grove High School
426 Pike Valley High School
501 Topeka high School
--- Maur Hill – Mount Academy

CHEMISTRY PARTICIPANTS				
Ma Lourdes Dakis	Jack Kyle	John Young	Laura Sixta	Erica Huggard√
Connie Ferree	Millie Laughlin	Michael Philbrick		Terri Nicholoson√
Mitch Spade	Ron Lewis	Michaelyn Podany		Morning Pruitt√
Tammi Wirsig	Rusty Lueger	Gene Wirsig		Mike Spade√
Carol Khol	Bobbie Jo Moran	Judy Seidl		Jim Swink√
				Nick Fraenza

Semester: First (16), Second (6)
Gender: Female (11), Male (11)
Ethnic: White Caucasian (20), Asian (1), Hispanic (-), African American (-), Not Disclosed (1)
Area: Urban (3), Suburban (5), Rural (13), Not Disclosed (1)

Grade/Subject:

TEACHING SUBJECT	GRADE LEVEL	NUMBER OF PARTICIPANTS	TEACHING SUBJECT	GRADE LEVEL	NUMBER OF PARTICIPANTS
Aerospace Science		1	English	10	1
Algebra II	10-11	1	General Science	6-8	5
Biology	9-12	5	Geometry		1
AP Biology		2	Gifted		1
Advanced Biology	11-12	2	Honors Chemistry		1
Calculus	12	1	Learning Disabled		1
Pre-Calculus	11-12	1	Life Science	6-8	4
Chemistry Building Blocks	7-8	2	Life Science	7-12	1
Chemistry I		14	Mathematics	6-8	3

Chemistry II		6	Mentally Retarded	9-12	1
AP Chemistry		2	Pre Engineering		1
College Algebra		1	Physical Science	9-12	6
Computer Science		1	Physical Science	6-8	2
Earth/Space Science		8	Physics I		9
Ecology		1	Technology	9-12	2
Environmental Science		1			

Area of Certification:

CERTIFICATION	NUMBER OF PARTICIPANTS	CERTIFICATION	NUMBER OF PARTICIPANTS
Physics (Grades 9-12)	11	MS Special Education	1
Earth Science (Grades 9-12)	4	Math (7-12)	2
Chemistry (Grades 9-12)	15	General Science (9-12)	5
Science (5-8)	8	Technology Education	2
Biology (9-12)	11	Special Education	2
Elementary Education(K-8)	3	Bussiness	1
ESOL	1	Bilingual	1
Physical Science(9-12)	2		

Highly Qualified Area:

CERTIFICATION	NUMBER OF PARTICIPANTS	CERTIFICATION	NUMBER OF PARTICIPANTS
9-12 Algebra	1	9-12 General Science	7
6-8 Biology	9	9-12 Geometry	1
9-12 Biology	10	5-8 Life Science	4
11-12 Advanced Biology	6	9-12 Life Science	6
9-12 Field Biology	2	7-12 Mathematics	2
9-12 Calculus	1	5-8 Mathematics	1
9-12 Pre-Calculus	1	7-12 Mentally Retarded	-
6-8 Chemistry	12	9-12 Pre Engineering	-
9-12 Chemistry	13	5-8 Physical Science	8

6-12 Earth & Space Science	4	9-12 Physical Science	7
9-12 Ecology	4	6-8 Physics	9
5-8 English	2	9-12 Physics	8
Environmental Science	1	6-12 Special Education	1
5-8 General Science	8	6-8 Technology	1

Number of Schools Served: 17
Number of School Districts Served: 16

School Districts:

USD 115 Nemaha Central
USD 202 Turner
USD 229 Blue Valley
USD 232 De Soto
USD 243 Lebo-Waverly
USD 253 Emporia
USD 259 Wichita
USD 334 Southern Cloud
USD 336 Holton
USD 338 Valley Falls
USD 364 Marysville
USD 418 Mcpherson
USD 446 Independence
USD 464 Tonganoxie
USD 491 Eudora
Roman Catholic Diocese of Salina

2. PERFORMANCE OUTCOMES

This No Child Left Behind Improving Teacher Quality Grant project utilized a quantitative and qualitative approach to measure the evaluation of the Modeling Instruction Institute workshop: A Collaborative Proposal by Fort Hays State University and Emporia State University. The report includes outcomes achieved, assessment data, project strengths and weaknesses, and future project modifications.

Objectives:

1. *Increased content knowledge of teachers in physics and chemistry content.*

To assess participants' increased physics content knowledge, first semester physics teachers took the Force Concepts Inventory (FCI) and Mechanics Baseline Test (MBT) pretests on the first workshop day and the posttests at the end of the workshop. Second semester physics teachers took the Electricity and Magnetism (E & M) pretest on the first workshop day and the posttest at the end of the workshop. To assess participants' increased chemistry content knowledge, chemistry teachers took a Matter Concepts Inventory (MCI) pretest on the first workshop day and a posttest at the end of the workshop.

Inventory	Teachers' Pre-test Average	Teachers' Post-test Average	One-tailed, paired t-test
Force Concepts Inventory	19	19	Alpha = 4x10^-6
Mechanics Baseline Test	18	19	Alpha = 0.01

The reported number for first semester physics teachers who significantly increased their knowledge of physics was based on the Force Concepts Inventory pre-test and post-test data collected from both inventories. A total of 19 (N=19), middle school through high school teachers participated in the FCI pre-test assessment. A total of 19 (N=19), middle school through high school teachers participated in the FCI post-test assessment. The pre-test was administered prior to the implementation of the physics workshop and a post-test was administered at the end of the modeling workshop. Teachers were asked to answer 30 multiple-choice questions.

A one-tailed, paired t-test was used to analyze the physics FCI pre-test and post-test. The t-test assessed whether the means of two groups were statistically different from each other. The average teacher mean score on the 30-point pre-test was 19 points and average teacher mean score on the post-test was 19 points. The average teacher standard deviation on the pre-test was 7.72 and average teacher standard deviation on the post-test was 5.94. The data collected on the one-tailed, paired T-test showed a significant gain in content knowledge with alpha = 4x10^-6.

The reported number for first semester physics teachers who significantly increased their knowledge of physics was based on the Mechanics Baseline Test (MBT) pre-test and post-test data collected from both inventories. A total of 19 (N=19), middle school through high school teachers participated in the MBT pre-test assessment. A total of 19 (N=19), middle school through high school teachers participated in the MBT post-test assessment. The pre-test was administered prior to the implementation of the physics workshop and a post-test was administered at the end of the modeling workshop. Teachers were asked to answer 20 multiple-choice questions.

A one-tailed, paired t-test was used to analyze the physics MBT pre-test and post-test. The t-test assessed whether the means of two groups were statistically different from each other. The average teacher mean score on the 20-point pre-test was 18 points and average

teacher mean score on the post-test was 19 points. The average teacher standard deviation on the pre-test was 4.36 and average teacher standard deviation on the post-test was 4.74. The data collected on the one-tailed, paired t-test showed a significant gain in content knowledge with Alpha = 0.01.

Inventory	Teachers' Pre-test Average	Teachers' Post-test Average	One-tailed, paired t-test
Electricity and Magnetism	11	13	Alpha = 0.01

The reported number for second semester physics teachers who significantly increased their knowledge of physics was based on the Electricity and Magnetism (E & M) pre-test and post-test data collected from both inventories. A total of 6 (N=6), middle school through high school teachers participated in the E & M pre-test assessment. A total of 6 (N=6), middle school through high school teachers participated in the E & M post-test assessment. The pre-test was administered prior to the implementation of the physics workshop and a post-test was administered at the end of the modeling workshop. Teachers were asked to answer 20 questions.

A one-tailed, paired t-test was used to analyze the physics E & M pre-test and post-test. The t-test assessed whether the means of two groups were statistically different from each other. The average teacher mean score on the 20-point pre-test was 11 points and average teacher mean score on the post-test was 13 points. The average teacher standard deviation on the pre-test was 2.07 and average teacher standard deviation on the post-test was 1.36. The data collected on the one-tailed, paired t-test showed a significant gain in content knowledge with Alpha = 0.01.

Inventory	Teachers' Pre-test Average	Teachers' Post-test Average	One-tailed, paired t-test
Chemistry Concepts Inventory	20.5	23.25	Alpha = 0.01

The reported number for first semester chemistry teachers who significantly increased their knowledge of chemistry was based on the Chemistry Concepts Inventory pre-test and post-test data collected from both inventories. A total of 16 (N = 16), middle school through high school teachers participated in the CCI pre-test assessment. A total of 16 (N = 16), middle school through high school teachers participated in the CCI post-test assessment. The pre-test was administered prior to the implementation of the chemistry workshop and a post-test was administered at the end of the modeling workshop. Teachers were asked to answer 29 multiple-choice questions.

A one-tailed, paired T-test was used to analyze the chemistry pre-test and post-test. The t-test assessed whether the means of two groups were statistically different from each other. The average teacher mean score on the 30-point pre-test was 20.5 points and average teacher mean score on the post-test was 23.25 points. The average teacher standard deviation on the pre-test was 5.80 and

average teacher standard deviation on the post-test was 5.12. The data collected on the one-tailed, paired t-test showed a significant gain in content knowledge with Alpha = .01.

Second semester chemistry teachers (N = 6) were not assessed on a pre- or post-test.

Logbooks

To assess participants' increased physics content knowledge, each participant was asked to keep a daily logbook of problems solved, labs done, and personal notes and reactions to the labs and activities that occurred during the summer workshop. Also summaries and reflections on the reading and comments on expected student difficulties and how to address them were recorded. Peer leaders evaluated logbooks periodically by using a scoring rubric, which addressed completeness of assignments and degree of understanding of implications of using the Modeling Method. All participants received a letter grades on their logbooks.

Physics Logbook Grades:

GRADES	A	B	C	D	F/U	I
1st Semester Physics Participants	15	1	0	0	0	2
2nd Semester Physics Participants	6	0	0	0	0	0

Chemistry Logbook Grades:

GRADES	A	B	C	D	F/U	I
1st Semester Chemistry Participants	16	0	0	0	0	0
2nd Semester Chemistry Participants	6	0	0	0	0	0

2. *Improved instructional strategies, including effective classroom discourse management and content organization.*

First-Week Workshop Survey

Participants completed a survey after the first week of the Modeling Instruction Institute workshop to assess participants' suggestions for the second week. Three questions were on the mid-workshop survey. Results of the data and comments were collected and recorded (see Appendix A). Forty-three (43) teachers completed the survey by rating the first week of the Modeling Instruction Institute workshop and offering suggestions for improvement. Three (3) FHSU participants and one (1) ESU participant did not complete the 7-14-2011 weekly workshop survey.

Teachers were given the opportunity to provide comments on what improvements they would recommend for the second week in the physics workshop at Fort Hays State University (FHSU) and the chemistry workshop at Emporia State University (ESU). One teacher noted, "I feel like I haven't seen a true modeling cycle yet due to the excessive "teacher" time. It would be helpful to experience at least one full lab experience without learning our "student" roles." Another teacher wrote, "Continue the high level of work and expectation that we started with." These responses are significant to the project objectives of improving instructional strategies, including effective classroom discourse management and content organization. Other comments were similar, showing a positive response to the first week of the modeling workshop. Three (3) FHSU participants and one (1) ESU participant did not complete the 7-14-2011 weekly workshop survey.

Teachers wrote comments on topics that they would like more training, information and/or instruction. One teacher noted, "Implementation of curriculum as it pertains to classroom policy/procedure such as: What does a typical day look like? How is the course graded?" Another teacher wrote, "I would like more information, or have it modeled, how to choose presenters to tell a story in the whiteboarding presentations." Again, these responses are significant to the project objectives of improving instructional strategies, including effective classroom discourse management and content organization. Other comments were similar, showing a positive response to the first week of the modeling workshop. Three (3) FHSU participants and one (1) ESU participant did not complete the 7-14-2011 weekly workshop survey.

When teachers were asked to rate the workshop, of the twenty-five (25) teachers participating in the physics workshop at Fort Hays State University and twenty-two (22) teachers participating in the chemistry workshop at Emporia State University, eighty-three (83) percent (N = 47) of the total teachers rated the workshop an four or higher on a scale from one (1) being "does not meet" expectations to five (5) being "greatly exceeds" expectations. Six (6) percent (N = 47) of the teachers rated the workshop a three. Two (2) percent (N = 47) of the teachers rated the workshop a two or lower. Nine (9) percent (N = 47) of the teachers did not rate the survey. One teacher noted, "There are several people who have never attended a modeling workshop or have never attempted modeling in their classroom. I have also noticed that several people experience in modeling instruction are dominating the class discussions. Can you make an effort to quell the off task questions – typically not as a "student" but asked as a teacher? I think teachers new to modeling are unwilling to speak up or ask questions about learning modeling instruction due to the "war stories" and side bar conversations. Perhaps teachers who want to discuss as a "teacher" rather than role-playing as a "student" could have their discussions at the break. Please continue to model as the teacher – resisting the tendency to "wear your teacher hat." An idea is to have a "parking lot." This is a piece of paper posted on the wall labeled "parking lot." Teachers can write down questions, ideas, etc. on it. You can address these at an appropriate time. This might help reduce the disruptions. A final concern is casual teacher comments openly disparaging students. Things such as "my kids can't do that…" and "my students come to me not knowing…" I believe teachers should model having positive expectations for our students. I mention this because it creates a tone for the classroom setting. The focus needs to be on learning modeling and I am afraid that is being lost. Please see me with concerns or questions." Another teacher wrote, "I like the

addition of the "parking lot" I think that helps cut down the distractions from the modeling experience. Another idea to help separate the teacher/student characters might be to have a specific time when we debrief the lab as teachers. "OK – let's put on our teacher hats and talk about it as teachers." I love the homework worksheets. Expands and solidifies learning." Other comments were similar, showing a positive response to the first week of the modeling workshop. Three (3) FHSU participants and one (1) ESU participant did not complete the 7-14-2011 weekly workshop survey.

Second-Week Workshop Survey

Participants completed a survey after the second week of the Modeling Instruction Institute workshop to assess participants' suggestions for the third week. Three questions were on the workshop survey. Results of the data and comments were collected and recorded (see Appendix B). Forty-two (42) teachers completed the workshop survey by rating the second week of the Modeling Instruction Institute workshop and offering suggestions for improvement. Four (4) FHSU participants and one (1) ESU participant did not complete the 7-21-2011 weekly workshop survey.

Teachers were given the opportunity to provide comments on what improvements they would recommend for the third week in the physics workshop at Fort Hays State University (FHSU) and the chemistry workshop at Emporia State University (ESU). One teacher noted, "Forewarn people about all the work expected (I know its been done, but a lot of colleagues are still being surprised). Help set us a "tutoring" session." Another teacher wrote, "Take out written article reflections; they take too much time away from method/ content practice and review. Maybe brief comments session if they still must be read." These responses are significant to the project objectives of improving instructional strategies, including effective classroom discourse management and content organization. Other comments were similar, showing a positive response to the second week of the modeling workshop. Four (4) FHSU participants and one (1) ESU participant did not complete the 7-21-2011 weekly workshop survey.

Teachers wrote comments on topics that they would like more training, information and/or instruction. One teacher noted, "Just a little information on pacing in general. Approx how long should each unit take?" Another teacher wrote, "Review instruction on the topics to be discussed. Connections between existing material and desired/ missing materials (K and equilibrium)(ΔS and equilibrium)(equilibrium game and lab data)." Again, these responses are significant to the project objectives of improving instructional strategies, including effective classroom discourse management and content organization. Other comments were similar, showing a positive response to the second week of the modeling workshop. Four (4) FHSU participants and one (1) ESU participant did not complete the 7-21-2011 weekly workshop survey.

When teachers were asked to rate the workshop, of the twenty-five (25) teachers participating in the physics workshop at Fort Hays State University and twenty-two (22) teachers participating in the chemistry workshop at Emporia State University, eighty-one (81) percent (N = 47) of the total teachers rated the workshop an four or higher on a scale from one (1) being "does not meet" expectations

to five (5) being "greatly exceeds" expectations. Nine (9) percent (N = 47) of the teachers rated the workshop a three. No participant rated the workshop lower than a three. Ten (10) percent (N = 47) of the teachers did not rate the survey. One teacher noted, "I have thoroughly enjoyed both the exposure to modeling and presentation (whiteboarding) as well as renewing some physics concepts. Taking notes in the dark and using unlabeled force diagramming on them were frustrating and marginal value." Another teacher wrote, "I would rather have a longer workshop to go through every activity/worksheet, although I'm sure it would take a long time. I just want to make sure that I am comfortable with everything before I leave." Other comments were similar, showing a positive response to the second week of the modeling workshop. Four (4) FHSU participants and one (1) ESU participant did not complete the 7-21-2011 weekly workshop survey.

Modeling Instruction Institute Survey

A final survey was administered upon completion of the third year Modeling Instruction Institute workshop to assess participants' use of elements of the modeling method. Fourteen questions were on the Modeling Instruction Institute survey. Results of the data and comments were collected and recorded (see Appendix C). Forty-six (46) teachers completed the survey by rating the Modeling Instruction Institute workshop.

Overall question. When teachers were asked to rate the workshop, of the twenty-five (25) teachers participating in the physics workshop at Fort Hays State University and twenty-two (22) teachers participating in the chemistry workshop at Emporia State University, eighty-nine (89) percent (N = 47) of the total teachers rated the workshop an eight or higher on a scale from one (1) being "poor" to ten (10) being "excellent" and nine (9) percent (N = 47) of the teachers rated the workshop a six or seven. One (1) ESU participant did not complete the survey, which is two (2) percent of the teachers (N = 47).

1a. Teachers were given the opportunity to provide comments on how well the workshop materials were structured into the Modeling Instruction Institute physics models at Fort Hays State University (FHSU) and chemistry models at Emporia State University (ESU). Sixty-eight (68) percent of the FHSU and ESU comments (N = 47) indicated physics and chemistry models were perceived by teachers as an "excellent" or "very good" way to improve instruction in their classroom and thirty (30) percent of the FHSU and ESU comments (N = 47) indicated physics and chemistry models were perceived by teachers as a "good" or "adequate" way to improve instruction in their classroom. One (1) ESU participant did not complete the survey, which is two (2) percent of the teachers (N = 47).

1b. In addition to how the workshop materials were structured into models, teachers commented on ways the models would contribute to the improvement of physics or chemistry instruction. One teacher noted, "Models serve as instructional framework as well as assessment of student understanding." Another teacher wrote, "Models provide a framework for consistency in thought. If students understand the models, their thoughts should be consistent." Again, these responses are significant to the project objectives of

improving instructional strategies, including effective classroom discourse management and content organization. Other comments were similar, showing a positive response to the incorporation of modeling.

2a. Teachers provided comments on the clarity of the connection between the labs/activities and the modeling development in the workshop. Ninety-two (92) percent of the comments (N = 47) indicated that the modeling workshop was very clear/clear and six (6) percent indicated that the modeling workshop was somewhat clear/unclear. One (1) ESU participant did not complete the survey, which is two (2) percent of the teachers (N = 47).

2b. Teachers provided comments on the clarity of the connection between the classroom discussion and the modeling development in the workshop. Ninety-four (94) percent of the comments (N = 47) indicated that the modeling workshop was very clear/clear and four (4) percent indicated that the modeling workshop was somewhat clear/unclear. One (1) ESU participant did not complete the survey, which is two (2) percent of the teachers (N = 47).

3. In the category of workshop expectations, seventy-one (71) percent of the comments (N = 47) indicated that the teachers' expectations were fulfilled or went beyond their expectations and twenty-three (23) percent indicated that the modeling workshop was what he/she expected. Three (3) ESU participants did not complete the survey, which is six (6) percent of the teachers (N = 47).

4. Teachers wrote comments on what ways, if any, that the workshop fell short of their expectations. A teacher noted, "The number of middle-school teachers present seemed to bog us down getting through material. It had its value but may be best if separated." A participant wrote, "Would like to have more interaction with 2nd year students. (A chance to discuss implementation)." There was no apparent pattern with the other comments.

5. Teachers wrote comments on what ways, if any, that the workshop exceeded their expectations. A teacher noted, "I learned so much more and have stronger understanding of mechanics I didn't have before. Wasn't sure the workshop would benefit me when I signed up." A participant wrote, "I learned a GREAT deal!!! The mix of modeling materials and discussions with Kayvan was extremely beneficial – much improved over last year!" Another teacher commented, "I've taught for 23 years. As new things come along, I usually, don't find too much I like better, but I really can see how modeling can improve what I do." There was no apparent pattern with the other comments.

6. Teachers also provided comments on how the workshop affected their views about teaching physics or chemistry "enhance their teaching" or "reinforce their current practice." One physics teacher commented, "It changed my whole teaching style about physics, learn by inquiry, take lab results, and make the models." A chemistry teacher commented, "I wish I had not avoided chemistry in the past. My content knowledge and confidence have increased!" There was no apparent pattern with the other comments.

7. Teachers were given the opportunity to comment on what changes and implementations they would make in their teaching practice during the academic school year as a result of what they learned in the workshop. Ninety-four (94) percent of the teachers (N = 47) at both the FHSU and ESU sites responded positively about making changes in their teaching practice due to the Modeling Instruction Institute workshop by incorporating modeling, lecturing less, increasing lab time, or engaging students. Four (4) percent of the teachers (N = 47) were not sure about making changes in their teaching practice. There was no apparent pattern with the other comments. One (1) ESU participant did not complete the survey, which is two (2) percent of the teachers (N = 47).

8. Teachers were given the opportunity to comment on changes in their teaching practice as a result of what they learned in this workshop that they would be unable to implement during the academic school year. One teacher noted, "I have the ability to implement all these changes. My district is VERY keen on ALL teachers making these changes." Another teacher wrote, "All of them. I'll have more materials, background and experience to do so." There was no apparent pattern with the other comments.

9. Teachers commented on what their top priority to implement this year from your workshop learning. The teachers participating in the Physics and Chemistry Modeling Instruction Institute workshop at FHSU and ESU responded to this question. One teacher commented, "Modeling, not using traditional book/note taking. Not giving students lab handouts." A teacher noted, "I'm going to implement modeling from the start. There are a few topics I will do without modeling, But I am excited about Modeling." There was no apparent pattern with the other comments.

10. Teachers were asked if the duration of the workshop was appropriate. One teacher wrote, "Yes because it allowed time to experience and see the modeling cycle. I know of at least one participant who was 'converted'." A second semester participant noted, "Yes!! 3 weeks seems to be the limit for the "stress" that the learning creates – any less and we don't learn enough any more and we shut down." Another teacher commented, "Appropriate for what needed to be covered." These comments reiterated the other responses.

11. Teachers responded to whether or not they would participate in future Modeling Instruction Institute workshops. Ninety (90) percent of the teachers (N = 47) responded that they would participate in a Modeling Instruction Institute workshop and six (6) percent of the teachers (N = 47) responded that they were unsure if they would attend another Modeling Instruction Institute workshop. Two (2) ESU participants did not complete the survey, which is four (4) percent of the teachers (N = 47).

12. Teachers were given the opportunity to comment on the workshop leaders and their role in accomplishing the goals of the modeling workshop. Teachers at both the FHSU and ESU sites responded positively about their respective workshop leaders and the leaders' roles. One teacher noted, "Penny – very knowledgeable and helpful; Earl – Full of ideas and energy; Paul – very enthusiastic;

All – pleasure to work with." Another teacher wrote, "Kayvan was an asset this year – and was 'modeling' friendly." One chemistry teacher noted, "Wonderful! Alan was a great role model." A teacher commented, "The leaders were great but may need to be more involved with the process. Earl L. arrived for the 3rd week and was instrumental for focusing our efforts." Teachers at both the FHSU and ESU locations were pleased with the workshop leaders.

13. Teachers worked on developing and presenting lessons during the workshop. Five components were addressed throughout the workshop: laboratory activities, whiteboarding, class discussions, printed materials, and logs/journal reflections. Teachers were asked to rate the activities on a scale from one (1) being "poor" to ten (10) being "excellent."

Ninety (90) percent (N = 47) of the teachers responded by rating the laboratory activities an eight or higher. Two (2) percent (N = 47) of the teachers responded by rating the laboratory activities a 7, 6, or 5. Two (2) percent (N = 47) rated that the laboratory activities were a 4 or lower. Three (3) ESU participants did not complete the survey, which is six (6) percent of the teachers (N = 47).

Eighty-one (81) percent (N = 47) rated the whiteboarding activities an eight or higher on the same scale. Eleven (11) percent (N = 47) rated the whiteboarding activities a 7, 6, or 5. Four (4) percent (N = 47) rated that whiteboarding activites were a 4 or lower. Two (2) ESU participants did not complete the survey, which is four (4) percent of the teachers (N = 47).

Seventy-seven (77) percent (N = 47) responded by rating the class discussions an eight or higher on the same scale. Nineteen (19) percent (N = 47) responded by rating the class discussions a 7, 6, or 5. Zero (0) percent (N = 47) rated that class discussions were a 4 or lower. Two (2) ESU participants did not complete the survey, which is four (4) percent of the teachers (N = 47).

Ninety-four (94) percent (N = 47) responded that printed materials were an eight or higher on the same scale. Two (2) percent (N = 47) responded that printed materials were a 7, 6, or 5. Zero (0) percent (N = 47) rated that printed materials were a 4 or lower. Two (2) ESU participants did not complete the survey, which is four (4) percent of the teachers (N = 47).

Forty-one (41) percent (N = 47) responded that logs/journal reflections were an eight or higher. Forty-seven (47) percent (N = 47) responded that logs/journal reflections were a 7, 6, or 5. Six (6) percent (N = 47) rated that the logs/journal reflections were a 4 or lower. Three (3) ESU participants did not complete the survey, which is six (6) percent of the teachers (N = 47).

14. Teachers also provided suggestions on how to improve the workshop. One teacher commented, "Incorporate how to select presenters to tell a story during the whiteboard presentations mentioned but not sure if this was demonstrated. Establish norms of behavior and adhere to them: patience with students; texting, eating, etc.; student/teacher mode thing. Model how to use the unit organizer to capture learning." Another teacher wrote, "Allow nuts and bolts discussions – time to incorporate stages other teachers

have done – what worked well and how you changed it to meet needs of your students." A teacher commented, "Although journals and reflections had good content, they took away time that could have been better used. Plus this led to too much homework the first weeks." There was no apparent pattern with the other comments.

These comments are an indication that teachers are self-reporting the importance of the modeling workshop in helping them to improve their instructional strategies, effective classroom discourse management, and content organization in their classrooms.

3. *Improved instructional strategies, including effective classroom discourse management, and content organization.*

PROCESS GAINS: To assess efficacy of the participants' in implementing modeling methods, all teachers designed either a physics or chemistry unit.

Teachers developed, implemented, and evaluated teaching units throughout the academic school year that were designed during the 2011 summer Modeling Instruction Institute workshop. The workshop built on improving teachers' modeling and content knowledge. Additional focus was devoted to making more frequent connections of the activities with students' real world experiences and increasing deliberate probing of students' common misconceptions. Participants presented their units to students during the academic school year. A project team evaluator observed participants using the Science Teaching Analysis Matrix (STAM) to evaluate the teaching environment of workshop participants.

The STAM is an observation tool to classify teaching styles from didactic, transitional, conceptual, early constructivist, constructivist, and experienced constructivist. Research indicates that effective teaching occurs with the conceptual classification. The STAM observation was conducted either directly in the classroom or through a Skype observation. The rubric measured teacher actions along with teacher knowledge, interactions with the content, interactions with students, student-to-student interactions, and classroom physical environment.

To assist and support teachers as they implemented Modeling instruction, an instructional coaching program was implemented. Classroom teachers were observed while they were using the Modeling approach, and the coach and teacher met after the observation to examine and reflect on practice with a strong focus on student learning. Research has demonstrated that coaching can provide professional development that can lead to sustained implementation of a new teaching practice. This service was provided to augment the electronic professional learning community that met six times during the academic year. Most of the coaching visits were done on site, and a few were done by Skyping the classroom. The Reform Teacher Observation Protocol was used to determine to what extent the teachers were using reform teaching, and provide a focus for discussion. The coach also met with the high school principal during

these visits when possible. The purpose of the meeting was to get any feedback about the implementation of Modeling Instruction, and to answer any questions they may have.

Secondary Science Teaching Analysis Matrix (STAM)

Content						
	Didactic	Transitional	Conceptual	Early Constructivist	Experienced Constructivist	Constructivist Inquiry
Structure of Content			7	3	5	
Examples	1		8	5	1	
Limits		2	6	3	4	
Processes	1	5	4	4	1	
Teacher's Actions and Assessment						
Methods	2	3	8	2		
Labs				4	3	
Teacher-Student Interactions			3	6	6	
Teacher Questions			2	9	3	
Kinds of Assessment			2			
Uses of Assessment		1		1		
Teacher Responses			9	5	1	
Students' Actions						
Writing Ideas		1	4	8	1	
Student Questions		2	4	6	2	
Student-Student Interactions		1	3	6	4	
Student Initiated Activity		1			1	

Student Understanding of Expectations			4	10	1	

Discussion and Concussions

Modeling Instruction is not an easy pedagogical approach to implement. Most of the coaching visits were done on site with trips scheduled to various parts of the state. These coaching visits shift the learning from the workshop to actual professional practice in the classrooms. It provides teachers an opportunity to collaborate and reflect on their teaching, and promoted the implementation of the learning. It was observed that many of the teachers have fully implemented MI while others adapted elements of modeling.

Of those participants observed, about two thirds of the teachers would be classified as having conceptual or early constructivist teaching styles according to the STAM. A third of the teachers would be classified as having didactic, transitional, or constructivist teaching styles. No participant was classified as having an experienced constructivist teaching style.

About one third of the teachers observed had students doing a laboratory investigation during the coaching visit. While this is an important part of MI, it did not allow the coach to see how students functioned in the class nor to what extent the class was student-centered. It is hard to tell how fully the teacher had implemented the reform from observing a lab.

Some teachers are well advanced in their understanding of MI and implementation. Students knew what the expectations were for them in the class and seemed to use class time very effectively. Others will benefit from more practice and reflection. The discussion sessions focused on the positives of what teachers were doing. Usually only one or two suggestions were made for improvement if warranted.

While teachers benefited from the interaction with an instructional coach, they need to remember that it will take years to build expertise in using this science reform teaching practices. They are encouraged to continual reflect on their professional practice, and set SMART goals for improvement based on data of student learning. The Reform Teaching Observation Protocol is a tool that should be used as to guide their thinking.

General recommendations for improvement for teachers working with students in a MI classroom based on observations made in the classrooms:

- Give students more opportunity in designing labs on their own
- Implement student-centered learning environments early in the year and reinforce and encourage regularly throughout the school year

- Address student motivation issues encouraging students to take more responsibility for learning
- Encourage students to ask questions of each other to construct understanding in a classroom learning community

Reports by workshop leaders during follow-up meetings determined that the success of the third year cycle was due to modeling. During the previous two years project evaluators had the chance to observe teachers implementing different methodologies that they learned about during professional development summer workshops. Teachers created a physics or chemistry unit, collaborated with other teachers at FHSU and ESU to improve their science modeling method, then implemented their unit within their respective classrooms. The students' diagnostic and summative evaluations were evaluated. Based on this experience, the project evaluators believe that modeling instruction exceeded the needs of physics and chemistry teachers. Modeling also exceeded their most optimistic expectations and the participants are looking forward to the third year of the three-year grant workshop.

4. *Increased student achievement.*

During the 2011-2012 academic school year, teachers administered a Force Concepts Inventory (FCI), Matter Concepts Inventory (MCI), or Assessment of Basic Chemistry Concepts (ABCC) diagnostic base-line assessment to pre-measure students' readiness to engage in the physics or chemistry unit. While implementing the unit, formative assessments were administered throughout the lessons to evaluate continued student learning. The FCI, MCI, or ABCC pre-test, used to pre-measure students' readiness, was also used as a post-test to measure the impact on student learning. State assessments were administered during the academic school year in some of the classrooms.

Inventory	Students' Pre-test Average (N = 353)	Students' Post-test Average (N = 464)	Standard Deviation Pre-test	Standard Deviation Post-test	One-tailed, Unpaired T-test	Effect Size
Force Concepts Inventory	7	8	2.54	4.28	Alpha = 1x10^-8	0.53

The reported number for students who significantly increased their knowledge of physics was based on the Force Concepts Inventory pre-test and post-test data collected from both inventories. A total of 353 middle school through high school students participated in the FCI pre-test assessment. A total of 464 middle school through high school students participated in the FCI post-test assessment. The pre-test was administered prior to the implementation of the physics unit and a post-test was administered at the end of the modeling unit. Students were asked to answer 30 multiple-choice questions.

A one-tailed, unpaired t-test was used to analyze the physics pre-test and post-test. The t-test assessed whether the means of two groups were statistically different from each other. The average student mean score on the 30-point pre-test was 7 points and average student mean score on the post-test was 8 points. The average student standard deviation score on the 30-point pre-test was 2.54 points and average student standard score on the post-test was 4.28 points. The level of significance was alpha= 1x10^-8. The effect size, which quantifies the differences between the two scores, was 0.53. The data collected on the one-tailed, unpaired T-test showed a medium practical significance, which was large enough to be observable.

Inventory	Students' Pre-test Average (N = 107)	Students' Post-test Average (N = 102)	Standard Deviation Pre-test	Standard Deviation Post-test	One-tailed, Unpaired T-test	Effect Size
Matter Concepts Inventory	13	17	4.87	8.28	alpha= 2x10^-8	0.91

The reported number for students who significantly increased their knowledge of chemistry was based on the Matter Concepts Inventory pre-test and post-test data collected from both inventories. A total of 107, middle school students participated in the MCI pre-test assessment. A total of 102, middle school students participated in the MCI post-test assessment. The pre-test was administered prior to the implementation of the chemistry unit and a post-test was administered at the end of the modeling unit. Students were asked to answer 30 multiple-choice questions.

A one-tailed, unpaired t-test was used to analyze the chemistry pre-test and post-test. The t-test assessed whether the means of two groups were statistically different from each other. The average student mean score on the 30-point pre-test was 13 points and average student mean score on the post-test was 17 points. The average student standard deviation score on the 30-point pre-test was 4.87 points and average student standard score on the post-test was 8.28 points. The level of significance was alpha=2x10^-8. The effect size, which quantifies the differences between the two scores, was 0.91. The data collected on the one-tailed, unpaired T-test showed a large significance, which was grossly perceptible.

Inventory	Students' Pre-test Average (N = 444)	Students' Post-test Average (N = 380)	Standard Deviation Pre-test	Standard Deviation Post-test	One-tailed, Unpaired T-test	Effect Size
Assessment of Basic Chemistry Concepts	9	12	3.50	4.97	alpha= 4x10^-25	0.93

The reported number for students who significantly increased their knowledge of chemistry was based on the Assessment of Basic Chemistry Concepts pre-test and post-test data collected from both inventories. A total of 444, high school students participated in the ABCC pre-test assessment. A total of 380, high school students participated in the ABCC post-test assessment. The pre-test was administered prior to the implementation of the chemistry unit and a post-test was administered at the end of the modeling unit. Students were asked to answer 29 multiple-choice questions.

A one-tailed, unpaired t-test was used to analyze the chemistry pre-test and post-test. The t-test assessed whether the means of two groups were statistically different from each other. The average student mean score on the 29-point pre-test was 9 points and average student mean score on the post-test was 12 points. The average student standard deviation score on the 29-point pre-test was 3.50 points and average student standard score on the post-test was 4.97 points. The level of significance was alpha= 4x10^-25. The effect size, which quantifies the differences between the two scores, was 0.93. The data collected on the one-tailed, unpaired t-test showed a large significance, which was grossly perceptible.

The test results reported show a grossly perceptible significant increase between the pre-test and post-test at all levels where both tests were administered. Therefore, teachers recently acquired knowledge on modeling instruction culminated in improved instructional pedagogy, inquiry methods, critical and creative thinking, cooperative learning, and effective use of classroom technology, which ultimately impacted student learning.

Reports by workshop leaders during follow-up meetings determined that due to the success of the first and second year cycles, participants were able to create and implement a successful modeling unit during the third year cycle of the grant, collaborate with other teachers to improve their unit, and implemented their unit within their respective classrooms.

3. MODIFICATIONS

The evaluation data was useful in helping to determine changes from the 2009-2010 and 2010-2011 modeling workshops to the 2011-2012 modeling institute workshop. The modifications are indicated below:

a) Usefulness in the teachers' curriculum.

The evaluation data indicates that the teachers find the modeling method to be a powerful technique for teaching. The project administrators decided that FHSU and ESU teams would jointly develop modeling units, a request by teachers from previous modeling grant workshops, and distribute these units to all participants. The allocation of workshop time for teacher teams to develop a physics or chemistry modeling instructional unit was beneficial. During the academic year, teachers implemented and evaluated the

unit they developed. In the future, teachers could implement and evaluate an additional unit developed by a peer group, if time allowed. A reason for this approach is to encourage greater use of modeling material that is appropriate for the teachers' classrooms.

To improve the Science Teaching Analysis Matrix (STAM) for direct classroom observations, a higher level of interaction was used to move the participants forward. The project administrators were correct in their feeling of the need to hire a coach at FHSU and ESU. The coach was able to provide suggestions for improved instructional strategies, including effective classroom discourse management and content organization. The coach was also able to set up multiple observations in order to visit the teachers on a specific date and time that would work for all parties involved.

b) Gains in student knowledge

A review of the data related to student gains indicates a positive impact, which was expected since the diagnostic and summative assessments are based on the verbatim teaching of the provided modeling materials and instructional unit developed. As part of the change to have teachers engage in curriculum development of modeling units that align with Kansas Standards, the measures used for students' gains were tied to those developed as part of the units.

c) Balance of teaching on IPTV.

Overall the workshop in year three was successful for teaching teachers' content, causing the teachers to rethink their pedagogical models and to move from consumers of curriculum to producers. In order to improve the modeling workshop in year three, project administrators had participants attend the workshop four days a week over a period of three consecutive weeks. During the third year, participants worked jointly to develop modeling units to be used in the their classrooms. Project administrators made a focused effort to make greater use of technology such as Wikis, IPTV, Adobe Connect Live, and Skype, which brought about a better balance of lead teaching between the two content areas.

Report submitted by Beth R. Walizer

Appendix A

First-Week Workshop Survey on 7-14-2011

Participants completed a first-week workshop survey after the first week of the Modeling Instruction Institute workshop to assess participants' suggestions for the second-week.

Question 1: **What improvements would you recommend for next week?**

FHSU 1st Semester:

- I am learning and trying to figure everything out. Its coming, I do not know what should come next.
- Reduce sidebar conversations (yes, I'm guilty) during whiteboard presentations.
- No comment.
- No weekend homework! HAAA
- Continue to model the questions that are expected to be asked and answered of students at the appropriate learning stage. Model what might be good questions for students to produce for the whiteboarding.
- No comment.
- If this is a beginning workshop, less theory, more basics. I won't use beyond basics to start.
- I feel like I haven't seen a true modeling cycle yet due to the excessive "teacher" time. It would be helpful to experience at least one full lab experience without learning our "student" roles.
- First day seemed a little confusing. Maybe a little more of an overview (roadmap) at the beginning of the week.
- We are getting too lost in the details of modeling. It is difficult to get a true sense of the cycle. Go through one activity with no "teacher mode" until after it's done. I like the labs!
- Make the pacing faster. Other concerns must be on the parking lot of issues/ideas.
- Norms for attention – cut out a lot of side conversation.
- More homework. Less tolerance for tangents – maybe have students in class write down applications in teacher mode and share in 20 minutes at end of day.
- Keeping the restriction on time needs to be continued. Need to really stress "make mistakes."
- Stop side conversations. More "DOING" and less "TALKNG." Less chiefs more Indians. Run this like a classroom no more allowing "teacher mode." Speed up. There is 1 facilitator.
- Less time for whiteboarding and more facilitation when things get off of certain topic.

FHSU 2nd Semester:

- No comment.
- No comment.
- None.

- Stay the same.
- My biggest challenges this week were that I'm really rusty and had too many personal distractions.
- OK.

ESU 1st Semester:

- I think everything is moving at a great pace. The discussions are fantastic. Continue this!
- Less homework
- Get AC working better or to a different lecture room.
- Let students lead white boarding?
- Continue the high level of work and expectation that we started with.
- Add more personal stories and tips from your own experience teaching it!
- Catch up- cut us philosophically sooner- so we get full benefit of course
- The workshop is going well. Lots of variety and interesting. It has been very useful.
- Stay on task more in class. We got on too many tangents.
- No comment.

ESU 2nd Semester:

- For group to check each other on task and a goal for the week on what units we should have completed.
- Goal per week
- More guidance in the unfamiliar concepts.
- A peer leader might help with experience using the materials.
- Someone in the room that has attempted to use this curriculum in an actual classroom setting. More guidance on the unfamiliar material.
- No comment.

Question 2: **What topics would you like more training, information, and or instruction?**

FHSU 1st Semester:

- Unknown.
- Photogate, set-up with various equipment my school has.
- How to prepare a lab set up so it goes smoothly.
- Anything you think. We love it all. Great stuff.
- I would like more information, or have it modeled, how to choose presenters to tell a story in the whiteboarding presentations.
- Photogate labs, how to set up my classroom, time and grading.

- Any and all … low skills!
- I know we need to cover the basics now. We are going through this very quickly for my students. I would like to know a little about pacing.
- Suggest texts, websites for 1. How to apply modeling in an AP lass where basically we cover a chapter a week.
- I want to get to the later units – I'm not as familiar with them. I'll be patient. ☺
- More hands-on on equipment/lab/computer.
- Labs are GREAT!
- No comment.
- Motion map introduction.
- Spend more time whiteboarding. Reading reviews just in notebook.
- 2D-Kinematics *Rotational and electricity ☹ 2nd semester I know.

FHSU 2nd Semester:

- I am still struggling with the idea of electric field as a conceptual idea. The math works – but what value to they have?
- No comment.
- None.
- Not sure at the moment.
- No comment.
- OK.

ESU 1st Semester:

- I'm okay with the concepts so far.
- I don't know
- It's already a perfect for week one.
- Get thru as of the units as possible. Maybe less emphasis on worksheets.
- I am really good and ready to take on whatever the course presents.
- Implementation of curriculum as it pertains to classroom policy/procedure such as: What does a typical day look like? How is the course graded?
- No comment.
- No comment.
- As stated in my unit 1 reflection- Examples of questions in printed or electronic form for the white boarding discussion.
- More unit introductions
- Identifying student misconceptions and questions. I am asking to identify them.
- No comment.

ESU 2nd Semester:

- RedOx, Electro Chemistry, Organic Chemistry, Nuclear Chemistry
- RedOx, Teaching chemical equilibrium
- redox
- Acid/ base chemistry
- Electrochemistry, pH Acid/ Base
- Electro Chemistry

Question 3: **How do you rate the experience this week on a scale from one (1) being "does not meet" expectations to five (5) being "greatly exceeds" expectations?**

Total number of teachers who rated the workshop a 5 or 4:
FHSU 1st Semester Participant(s) reporting 14 (N = 19)
FHSU 2nd Semester Participant(s) reporting 6 (N = 6)
ESU 1st Semester Participant(s) reporting 15 (N = 16)
ESU 2nd Semester Participant(s) reporting 4 (N = 6)
Participant(s) reporting at both universities 39 (N = 47), 83%
Total number of teachers who rated the workshop a 3:
FHSU 1st Semester Participant(s) reporting 1 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st Semester Participant(s) reporting 0 (N = 16)
ESU 2nd Semester Participant(s) reporting 2 (N = 6)
Participant(s) reporting at both universities 3 (N = 47), 6%
Total number of teachers who rated the workshop a 2 and under:
FHSU 1st Semester Participant(s) reporting 1 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st Semester Participant(s) reporting 0 (N = 16)
ESU 2nd Semester Participant(s) reporting 0 (N = 6)
Participant(s) reporting at both universities 1 (N = 47), 2%
Three FHSU first semester participants did not complete the 7-14-2011 weekly workshop survey.
One ESU first semester participant did not complete the 7-14-2011 weekly workshop survey.

Comments:
FHSU 1st Semester:

- I was going to quit and not come back, but it is getting better for understanding. Everybody says hang in there because it will come together.
- Confusing areas of physics are becoming more clear. Very helpful so far.
- Bringing other's ideas to get students involved in a learning community has helped me. This is the first time I have seen a really good application of whiteboarding. Bring a group member up to present. I really liked concept before vocab and enforcing proper vocab.
- What is the website?
- I like the addition of the "parking lot" I think that helps cut down the distractions from the modeling experience. Another idea to help separate the teacher/student characters might be to have a specific time when we debrief the lab as teachers. "OK – let's put on our teacher hats and talk about it as teachers." I love the homework worksheets. Expands and solidifies learning.
- I'm looking forward to get into deeper ideas and see how the modeling applies. I have found a whole new way to teach eq. and relationships.
- Workshop is really helping me open up my problem solving skills, and being able to better articulate data and what it means.
- No comment.
- So far so good!
- There are several people who have never attended a modeling workshop or have never attempted modeling in their classroom. I have also noticed that several people experience in modeling instruction are dominating the class discussions. Can you make an effort to quell the off task questions – typically not as a "student" but asked as a teacher? I think teachers new to modeling are unwilling to speak up or ask questions about learning modeling instruction due to the "war stories" and side bar conversations. Perhaps teachers who want to discuss as a "teacher" rather than role-playing as a "student" could have their discussions at the break. Please continue to model as the teacher – resisting the tendency to "wear your teacher hat." An idea is to have a "parking lot." This is a piece of paper posted on the wall labeled "parking lot." Teachers can write down questions, ideas, etc. on it. You can address these at an appropriate time. This might help reduce the disruptions. A final concern is casual teacher comments openly disparaging students. Things such as "my kids can't do that…" and "my students come to me not knowing…" I believe teachers should model having positive expectations for our students. I mention this because it creates a tone for the classroom setting. The focus needs to be on learning modeling and I am afraid that is being lost. Please see me with concerns or questions. –DL
- No comment.
- Did a better job on Thursday of do classroom management.
- I had a decent idea of what to expect. Great material, well-taught. Very valuable stuff well worth time and effort! I would encourage facilitators to re-read assigned materials. The motion map reading is not as definitive in roles of dots, arrows, etc. as you recall.
- The motion map notes need to be clarified/fixed. The reading direction issue is a concern esp. w/the ESL issue.

- I am very frustrated with the pace and the focus on pointless endeavers. We need to STOP the what if game.
- I feel as if we are constantly argueing and debating when presenter goes up to whiteboard. I wish the facilitator would step in and keep us on track more. Also, I really would like to have a visual of what we are going to do each day on the board in the morning to help keep us on schedule. I would like more lab examples lead by modeling as well. The second half of the lasd tay this week seems to be going etter, especially with the whiteboarding (Earl did great). But I would not want to come back or come to another modeling workshop if it continues like it has been the previous few days.

FHSU 2nd Semester:

- I like the fact that we have the ASU agenda – that has helped us move through the material in a better fashion as compared to last year.
- I am definitely learning and understanding electricity at a new level.
- Keep it up Earl!
- Enjoying it and feeling slightly stupid at the same time.
- No comment.
- Everything fine for me so far.

ESU 1st Semester:

- Any modeling of the future units will be helpful as I am new to the chemistry curriculum.
- I was expecting this to be a "fluff" workshop where we learned a lot but wouldn't have to strain our brain or so homework. I'm learning a lot, but it's a difficult time consuming class.
- The lab equipment is slightly ghetto. I'm surprised this being a university.
- We worked really hard all day long and then we worked in the evening on homework!
- A great week. I'm excited about using Unit 1 in my classes. Good Class
- Love the teaching method. Alan is doing a great job helping us to experience what the student experiences.
- Everything had been great so far.
- Things are just good the way they are.
- I have thoroughly enjoyed this. It keeps me thinking about what potential ideas can be added the course I am teaching.
- Organized materials, thorough treatment of units and activities.
- Class going well.
- I am to slow- eat, drink, and sleeping this curriculum. This was not expected.
- This is making me think and question my knowledge base. I have had some differences in the arena. Who is right? Uncertainty
- Keep it going! ☺ Instructor does a wonderful job teaching the class!
- We have a lot of people with different backgrounds in Chemistry. It creates both good and bad situations in a class like this.

- No comment.

ESU 2nd Semester:

- I've learned from my cohort about in-depth chemistry.
- I've also liked the self-learning pace.
- This is a good group and we are working well together.
- With six of us here we are able to work through any problems. Those that we still have questions on; Malonne has been there to get us to a great understanding.
- Since the curriculum materials are still being developed.
- No comment.

Appendix B
Second-Week Workshop Survey on 7-21-11

Participants completed a second-week workshop survey after the second week of the Modeling Instruction Institute workshop to assess participants' suggestions for the third week.

Question 1: **What improvements would you recommend for the third week?**

FHSU 1st Semester:

- Everything is good except we should start @ 8:30 except Thursday.
- None.
- Forewarn people about all the work expected (I know its been done, but a lot of colleagues are still being surprised). Help set us a "tutoring" session.
- I like labs! ☺
- Continue to see more "student" time.
- A new hotel, try to move a little faster.
- Faster pace. Even more labs!
- Continue to do more labs and demonstrations – get through the sest of the unit!
- So far, I cannot think of anything. It was much quieter during W. B. and sharing time.
- Nothing. You are going a GREAT job!
- Model how to tell a story with the whiteboarding. When it is time for reading – could this be designated as a quiet time?
- None. This week went really well.

- I felt the week went well.
- No comment.
- No comment.

FHSU 2nd Semester:

- I need to catch up.
- None.
- No comment.
- Can't think of any.
- No comment.
- No comment.

ESU 1st Semester:

- With the intensity of and quantity of the material, we need to be focused (fun but focused)-not really an improvement just kept it up. ☺
- Very happy with the class and instructor!
- Doing every problem isn't necessary for worksheets- Just samples.
- Nothing
- I know there will be a massive amount of ground to cover with one unit per day. I'm sure that we will get all we can handle.
- Emphasize getting thru activities rather than worksheets.
- No homework on Thursday for the weekend.
- No comment.
- Take out written article reflections; they take too much time away from method/ content practice and review. Maybe brief comments session if they still must be read.
- I didn't really like the readings this week and I am disappointed that some of the articles are not more recent.
- Be brutal! Keep us on track! I want to finish the entire course without rushing too much due to distractions.
- Reflections have taken away my focus of the class(i.e. chem concepts and teaching methods)
- Less reflection papers- allow more time to work on worksheets, especially when we are moving through the material quickly.
- If a reading is required, maybe discuss it quickly in class the next day
- Simply more time ☺
- No comment.

ESU 2nd Semester:

- None

- Dr. Davies input though short lecture/discussions on specific topics helped to understand where the curriculum is maybe moving.
- No comment.
- No comment.
- Dr. Davies input has been helpful – frequents clarifications are helpful.
- A modeling instructor that has used the Chem II curriculum for unit 12b and 13.

Question 2: **What topics would you like more training, information, and or instruction?**

FHSU 1st Semester:

- This is very difficult.
- Energy/thermodynamics.
- Need to rotate more teachers in "teacher-questioning" mode.
- Forces.
- Just a little information on pacing in general. Approx how long should each unit take?
- Energy and electricity.
- Whatever; springs and "stuff."
- How to set up for the new teacher. How often/when.
- Set up Lab Pro equipment. In my lab.
- Nothing. This is intense enough for me.
- How do you conduct the whiteboarding to "tell a story?" Earl mentioned in week 1 that he picks students in an order. Could this be modeled?
- N/A – so far, so good!
- Not sure.
- No comment.
- More on proper lab set up.

FHSU 2nd Semester:

- No comment.
- None.
- No comment.
- Magnetism.
- No comment.

- No comment.

ESU 1st Semester:

- For me, I just need personal time to reflect and plan!
- IDK
- No comment.
- No comment.
- No comment.
- I would like to spend some time on unit 8-9 stoichiometry. I'd like to see how Alan approaches this topic.
- Whiteboard Questioning- Let students do some?
- No comment.
- Synopsis of traditional topics modeling sequence topics
- What do colleges think of modeling prepped students?
- Questioning students and transitioning between
- I know we are in a time crunch, but I felt there were 'jumps" in the curriculum this week.
- After struggling thorough certain concepts I think I'm ok with the curriculum.
- No comment.
- No comment.
- No comment

ESU 2nd Semester:

- I like that Malonne is available as needed to help us over the rough parts.
- Equilibrium/ Enthalpy
- Review instruction on the topics to be discussed. Connections between existing material and desired/ missing materials (K_{eq} and equilibrium)(ΔS and equilibrium)(equilibrium game and lab data)
- I want more training on year 1. It is still my goal to complete all the worksheets for year 1.
- Entropy and Equilibrium
- How to use a colorimeter with I_2 or $Ca(OH)_2$ solubility lab.

Question 3: **How do you rate the experience this week on a scale from one (1) being "does not meet" expectations to five (5) being "greatly exceeds" expectations?**

Total number of teachers who rated the workshop a 5 or 4:

FHSU 1st Semester Participant(s) reporting 15 (N = 19)
FHSU 2nd Semester Participant(s) reporting 6 (N = 6)

ESU 1st Semester Participant(s) reporting 15 (N = 16)
ESU 2nd Semester Participant(s) reporting 2 (N = 6)
Participant(s) reporting at both universities 38 (N = 47), 81%

Total number of teachers who rated the workshop a 3:
FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st Semester Participant(s) reporting 0 (N = 16)
ESU 2nd Semester Participant(s) reporting 4 (N = 6)
Participant(s) reporting at both universities 4 (N = 47), 9%

Total number of teachers who rated the workshop a 2 and under:
FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st Semester Participant(s) reporting 0 (N = 16)
ESU 2nd Semester Participant(s) reporting 0 (N = 6)
Participant(s) reporting at both universities 0 (N = 47), 0%

Four FHSU first semester participants did not complete the 7-21-2011 weekly workshop survey.
One ESU first semester participant did not complete the 7-21-2011 weekly workshop survey.

Comments:

FHSU 1st Semester:

- Lost but that's ok.
- It's going great. The instruction is very much appreciated!
- Getting more and more. ☺ Penny is much better than my previous leader about letting me ask questions about pedagogical delivery and its level of effectiveness.
- This week has been much better.
- This week was much better in regards to staying on task. I felt like the week was more productive.
- Learning a lot to put into my classroom.
- This week went a lot better than last week. ☺
- No comment.
- I have thoroughly enjoyed both the exposure to modeling and presentation (whiteboarding) as well as renewing some physics concepts. Taking notes in the dark and using unlabeled force diagramming on them were frustrating and marginal value. BW
- No comment.

- Thank you for addressing Parking Lot issues in class. I think that is helpful. I think the worksheets provide a nice extension for learning. They are not just including learning from the class, but also seem to stretch the learning slightly.
- Excellent!
- No comment.
- No comment.
- I really like this unit 4. Its got visual training and breaking down what is going on.

FHSU 2nd Semester:

- Struggling a little this week. I need more self-discipline. I' getting behind.
- No comment.
- No comment.
- Got brain tired at the end of the week. Found it hard to stay on task on Thursday.
- This year has been very beneficial – I am really starting to get a handle on electric fields. I am still unsure of some concepts – but now have the skills to reason it out.
- I really don't know what to say. I feel like I' in way over my head.

ESU 1st Semester:

- ☺ Going well learning lots!
- Alan has done a great job answering "teacher" and "student" questions.
- Great Job
- Fabulous! Loving it!
- The course has been everything I expected and more. I have learned a lot and been challenged to grow.
- Class has been very good. Some of new units didn't have many activities? Students learn by doing!!
- Week went fast most days passed fast.
- Too much homework – one aspect should be social or events related (could go to a play)
- I would rather have a longer workshop to go through every activity/worksheet, although I'm sure it would take a long time. I just want to make sure that I am comfortable with everything before I leave.
- Have 2nd Semester concerns…
- I still really like the workshop and see many ideas that I want to implement.
- Still Very Good!
- Personally, I would prefer to discuss the reading material rather than write reflections. Reading, plus writing, takes me 2-3 hours. Yes, I am a slow reader and writer. ☺
- The changes in Unit 4 don't prepare students for Unit 5 worksheet 1.

- =formulas, multistep dimensional analysis, use of periodic table to find mass of 1 mole of a compound the concept that the atomic mass is equal to 1 mole of an element.
- No comment.

ESU 2nd Semester:

- We had only had one day that felt non-productive. After the day's work we as a group decided to skip that section. We don't have the rational that the group developing unit 12 has and so we struggled to make sense of it.
- I have a lack of the background in the Chem II curriculum since I haven't had contact with the curriculum since 1975.
- Frustration is high when materials are disjointed and incomplete.
- Eureka moments occur sometime to keep us going, but not often enough to prevent frustration sometimes. My teaching of Chem II is infrequent so my experience is sparse.
- This week was difficult for us because we are trying to fill in a rational for the purpose and sequence of the topics in the unit. We are still learning but it's a little disconnected. Malonne has been VERY helpful in explaining the curriculum when asked.
- Disjunction between the rational/overview in teacher's notes and the sequence of events in the unit. Sarah has been very helpful as well!

Appendix C
Modeling Instruction Institute Survey

Participants completed a Modeling Instruction Institute survey during the academic year following the workshop to assess their use of elements of the modeling method.

Overall Question: **Rate your workshop from 1(poor) to 10 (excellent).**
Total number of teachers who rated the workshop a 10, 9, or 8:
FHSU 1st Semester Participant(s) reporting 18 (N = 19)
FHSU 2nd Semester Participant(s) reporting 6 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 18 (N = 22)
Participant(s) reporting at both universities 42 (N = 47), 89%
Total number of teachers who rated the workshop a 7, 6, or 5:
FHSU 1st Semester Participant(s) reporting 1 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 3 (N = 22)
Participant(s) reporting at both universities 4 (N = 47), 9%
Total number of teachers who rated the workshop a 4 and under:
FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 0 (N = 22)
Participant(s) reporting at both universities 0 (N = 47), 0%
One ESU participant did not complete the survey. 2%

Question 1a: **How well were the workshop materials structured into models? (FHSU: physics or ESU: chemistry)**
Total number of teachers who responded "excellent" or "very good" "good":

FHSU 1st Semester Participant(s) reporting 14 (N = 19)
FHSU 2nd Semester Participant(s) reporting 5 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 13 (N = 22)
Participant(s) reporting at both universities 32 (N = 47), 68%

Total number of teachers who responded "good" or "adequate":

FHSU 1st Semester Participant(s) reporting 5 (N = 19)
FHSU 2nd Semester Participant(s) reporting 1 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 8 (N = 22)
Participant(s) reporting at both universities 14 (N = 47), 30%

Total number of teachers who responded "poor" or "N/A":

FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 0 (N = 22)
Participant(s) reporting at both universities 0 (N = 47), 0%

One ESU participant did not complete the survey. 2%

Question 1b: **In what ways do you see models contributing to the improvement of instruction?**
FHSU 1st Semester:

- It helps students get involved in their own learning.
- Well, I know how much I increased my understanding of physics.
- I am still unclear about what a "model" is … If a "model" is creating the mathematical equation from the graphical representation of the relationships, then it greatly enhanced my own understanding of physics.
- No comment.
- Students can be more actively involved and also have an opportunity to apply knowledge from other content areas.
- Yes – provides a new way of approaching concepts.
- No comment.
- No comment.
- They make problem solving and experiments together.
- I see this helping students gain an understanding of physics but also developing problem solving skills.
- Students can internalize material, better understanding, not just memorization.

- Helping the students understand where the equations come from and how to use them.
- Help students get a better understanding of what is really happening and not just formulas.
- No comment.
- Better problem solving skills, inquiry.
- No comment.
- I see the models adding to students' understanding of concepts and making sense of materials.
- No comment.
- Models serve as instructional framework as well as assessment of student understanding.

FHSU 2nd Semester:

- Improves students understanding of concepts
- Better understanding of concepts.
- Improvement in student thinking and understanding.
- If I could finish 1st semester it would be excellent as a 2nd year course of partial course.
- Knowing which models are being "modeled" can lead to better discussions.
- I think students will have a much better understanding of topics that they have actually experimented with.

ESU 1st Semester:

- Models provide a framework for consistency in thought. If students understand the models, their thoughts should be consistent.
- The visual, easier to understand - more student centered.
- Great for the visual learner.
- Increased understanding of concepts in Chemistry.
- Visual models help visual and tactile learners perform better and have good comprehension ability.
- Create students who can apply reasoning and problem solving skills to the real would and make life better.
- Better conceptual understanding and retentions higher level thinking.
- Makes kids responsible.
- Much better conceptual understanding for students.
- Pictorially correcting misconceptions.

ESU 2nd Semester:

- They are a great way for student to understand what they are learning and not memorizing formulas.
- Modeling students are more engaged and develop a deeper understanding.
- Student understanding is improved by modeling.
- Creating more understanding at a high school level.

- It makes abstract ideas more conceptual.

Question 2a: How clear to you was the connection between labs/activities and model development in the workshop?
Total number of teachers who responded "very clear" or "clear":
FHSU 1st Semester Participant(s) reporting 17 (N = 19)
FHSU 2nd Semester Participant(s) reporting 6 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 20 (N = 22)
Participant(s) reporting at both universities 43 (N = 47), 92%
Total number of teachers who responded "somewhat clear" or "not very clear":
FHSU 1st Semester Participant(s) reporting 2 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 1 (N = 22)
Participant(s) reporting at both universities 3 (N = 47), 6%
One ESU participant did not complete the survey. 2%

Question 2b: **How clear to you was the connection between classroom discussion and model development?**
Total number of teachers who responded "very clear" or "clear":
FHSU 1st Semester Participant(s) reporting 19 (N = 19)
FHSU 2nd Semester Participant(s) reporting 6 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 19 (N = 22)
Participant(s) reporting at both universities 44 (N = 47), 94%
Total number of teachers who responded "somewhat clear" or "not very clear":
FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 2 (N = 22)
Participant(s) reporting at both universities 2 (N = 47), 4%
One ESU participant did not complete the survey. 2%
Question 3: **Were your expectations of the workshop fulfilled, and if so, to what extent?**
Total number of teachers who responded that the workshop was "beyond his/her expectations":
FHSU 1st Semester Participant(s) reporting 14 (N = 19)
FHSU 2nd Semester Participant(s) reporting 5 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 14 (N = 22)
Participant(s) reporting at both universities 33 (N = 47), 71%

Total number of teachers who responded that the workshop was "what he/she expected":

FHSU 1st Semester Participant(s) reporting 5 (N = 19)
FHSU 2nd Semester Participant(s) reporting 1 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 5 (N = 22)
Participant(s) reporting at both universities 11 (N = 47), 23%

Three ESU participants did not complete the survey. 6%

Question 4: **In what ways, if any, has the workshop fallen short of your expectations?**

FHSU 1st Semester:

- None, it was Great. It opened up doors to become a better teacher.
- I would have liked to have gotten through all the material. We spent so much time whiteboarding, worksheets, and there was a lot of downtime.
- No comment.
- No comment.
- It did not fall short. I kept up as well as I could. I always felt included and I was not chastised when my understanding was slow.
- IT DID NOT.
- I wish we could've finished the units.
- Was a little concerned that the later units were not as well developed.
- To many experienced physics teachers with M.S. or new. Physics didn't always stay in student mode.
- No comment.
- It did not fall short.
- The only complaint I have was about the housing. The Ramada wasn't great.
- No comment.
- No comment.
- No comment.
- First week was rough – not enough lab time. Got better as workshop went on.
- The number of middle-school teachers present seemed to bog us down getting through material. It had its value but may be best if separated.
- It would be beneficial to hear more about how to overcome administrators/parents objections to modeling.
- Was looking for "modeling behavior" between "teacher" and "student."

FHSU 2nd Semester:

- Can't think of any.
- None.
- No comment.
- I didn't have any preconceived notions about what I was going to learn. I wish I would have had more time to discuss interventions.
- I would like to see a better scheduled agenda to operate from.
- It would have been nice if Earl could have spent more time with our class.

ESU 1st Semester:

- Would like to have more interaction with 2nd year students. (A chance to discuss implementation).
- I expected all the participants would be chemistry teachers. I was disappointed in the age of the articles we read.
- None
- None
- N/A
- More time to create a cohesive picture would've been great so my prior knowledge wouldn't cloud my understanding.
- I misread information and thought it would be more geared to middle school.
- Would like 2nd semester curriculum, as it becomes available.
- Not Really.

ESU 2nd Semester:

- We struggled with trying to understand the author's direction or intent.
- Not enough materials have been developed.
- I was not expecting to be asked to complete the curriculum. A lack of direction. We needed goals established.
- The units were not all complete that made it a little more difficult.
- We didn't spend a lot of time white boarding.
- We needed more guidance on the models.

Question 5: **In what ways, if any, has the workshop exceeded your expectations?**

FHSU 1st Semester:

- Working with other teachers who want to improve classroom engagement.
- No comment.
- Using data analysis in LoggerPro to find the relationships was a great way to create the math "models." That is a very easy place for people to start.
- The workshops help me keep abreast of the current trends in physics and science teaching.

- I felt "brought along" on a number of concepts to where I gained understanding and appreciation to area I long ago studied or to which I never had been exposed.
- By showing teachers a new approach and a new way of student demonstration of concepts.
- Excellent instruction – Penny Rocheel!
- Was able to start applying it better than when originally learned.
- Labs, whiteboard, and technology.
- I feel more confident in using this approach and reaching a productive end.
- I learned so much more and have stronger understanding of mechanics I didn't have before. Wasn't sure the workshop would benefit me when I signed up.
- The ways I can take labs and material that I'm already doing and apply to modeling and make students accountable.
- Very good applications of whiteboarding and how to get students to think about physics.
- Content.
- No comment.
- No comment.
- The opportunities to "practice" what students will be asked to do really seemed as a crucial benefit to attending.
- The lab activities were great! Simple, clear, and inexpensive.
- Accommodations. Much better than staying in the dormitories of Emporia State University.

FHSU 2nd Semester:

- Some of the ideas I got from fellow teachers.
- The accommodations.
- I learned content in E & M and gained labs that can be used to model these concepts.
- I learned more about electricity than expected. It greatly affirmed.
- I learned a GREAT deal!!! The mix of modeling materials and discussions with Kayvan was extremely beneficial – much improved over last year.
- The tour of the physics department was really cool. The night of using the 12" telescope was good too.

ESU 1st Semester:

- I've taught for 23 years. As new things come along, I usually, don't find too much I like better, but I really can see how modeling can improve what I do.
- I picked up content knowledge and teaching strategies.
- I enjoyed everyone in class and how hard everyone worked, I love the new ways to do stoich and limiting reactions.
- It revealed my misconceptions and took my understanding of certain concepts to a deeper level.
- The workshop exceeded because the materials are all designed to mesh and developed extremely well.

- I heard very good things about it, so I was expecting it to be very good,
- The lab activities and discussion.
- Getting to do so many labs first-hand! So helpful!! Great teacher with experience and advice :)
- I learned so much about modeling and chemistry that I apply in my classroom.
- Great Folks!
- Will probably try this pedagogy.
- I had no expectations.
- Alan Vancil-Awesome Job!
- I was challenged. I worked very hard to develop new and better ways to present the chemistry component of my Physical Science Class.

ESU 2nd Semester:

- We were able to complete several units.
- My "classmates" were very helpful.
- The collaboration with peers was amazing and they were very helpful.
- Readiness of personnel to set up labs quickly.

Question 6: **In what ways, if any, has the workshop affected your views about physics/chemistry and or physics/chemistry instruction?**

FHSU 1st Semester:

- How it goes along with math.
- No comment.
- It changed my views of physics. I wish I had learned it this way. I wish everyone who talk in terms of math relationships, as opposed to just getting answers from a formula.
- The workshops help me relearn some concepts I am struggling with. It also help me view teaching physics using the perspective of the students and how students learn.
- The workshop has given me new energy to learn more and to carefully study the materials presented (particularly the last week).
- I THOUGHT I know what V and A was!
- I can see that it isn't just a math class anymore.
- No comment.
- It greatly increased my understanding.
- My teaching style isn't a lot different but I think concepts can be developed more thoroughly.

- Energized me, ready to share with students and have them make connections.
- It changed my whole teaching style about physics, learn by inquiry, take lab results, and make the models.
- I NEED to change ways in which I present concepts to students.
- I was less prepared then I thought
- No comment.
- Gave me confidence.
- Cemented me.
- Modeling is definitely a good approach. I want to use it, but still feel pushed to cover material more quickly.
- A affirmation of the need to increase the level of student talk about mathematics and science.

FHSU 2nd Semester:

- No comment.
- It makes me more analytical.
- No comment.
- It reaffirmed my notion that the modeling method is the way we learn period.
- I am excited to include electricity in my physics class this year BECAUSE of my improved knowledge base.
- I am more convinced of the need to have kids take science.

ESU 1st Semester:

- Students must have conceptual understanding! If students get concepts right, the calculations will make more sense.
- I wish I had not avoided chemistry in the past. My content knowledge and confidence have increased!
- I am more interested in chemistry.
- There are multiple ways to do things!! Give the kids a chance to figure things out.
- Just confirmed my views and gave me the tools to achieve that in my classroom.
- Modeling changed the order and priorities in which I will teach.
- It definitely rejuvenated me. I feel a lot more excited about next year.
- I found Chemistry much more exciting to learn and more enjoyable to teach.
- I could never go back to how I thought last year. SO tiring!! This creates lasting learning.
- It showed me what I need to teach my middle school students to better ready them for high school (depth rather than width of information).
- Wow! Too much to say here! See course final reflection!
- Some good techniques but don't see all is concept based- not sure if curriculum is honest with itself not being algorithm in some areas e.g. stoichiometry.
- It was my first chemistry class and though a lot flew over my head, I think a lot stuck.

- It can be A LOT of fun…very engaging.
- I found some of the more difficult components of chemistry easier to understand and therefore should be easier to teach.

ESU 2nd Semester:

- This course reinforced my idea of modeling as a learning process.
- I enjoy Chemistry even more, deeper understanding.
- I now view energy as very important to chemistry.
- Understanding what is going on is so important but difficult for students. This helps.
- I learned more about Chemistry II topics.
- I still think that modeling is a good curriculum.

Question 7: **What changes, if any, do you feel you need to make in your teaching practice as a result of what you learned in this workshop?**

Total number of teachers who responded that they "will incorporate modeling, lecture less, increase lab time, or engage students":

FHSU 1st Semester Participant(s) reporting 18 (N = 19)
FHSU 2nd Semester Participant(s) reporting 6 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 20 (N = 22)
Participant(s) reporting at both universities 44 (N = 47), 94%

Total number of teachers who responded that they " were not sure":

FHSU 1st Semester Participant(s) reporting 1 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 1 (N = 22)
Participant(s) reporting at both universities 2 (N = 47), 4%

One ESU participant did not complete the survey. 2%

Question 8: **Which of the changes above will you be unable to implement this year? Why?**

FHSU 1st Semester:

- Modeling, engagement.
- All of them will be added this year.
- Whiteboarding fits very easily with our math workshop model, so I will be encouraging people to start with that. I will also encourage LoggerPro with data collection.
- No comment.
- Graded implementation is anticipated and we will see how much we can get done. Hopefully it will be substantial.
- Some of the math and some of the graphs.

- None (not teaching physics until next year).
- No comment.
- I hope to use as much technology and whiteboarding as possible but I am still unsure about how/when and how long to do what.
- No comment.
- I will try to implement all changes, they relate to each other.
- I feel that I already do a lot of labs so my tie won't change, just how we do it.
- No comment.
- No comment.
- No comment.
- No comment.
- None – should be able to incorporate all to some degree.
- No comment.
- I have the ability to implement all these changes. My district is VERY keen on ALL teachers making these changes.

FHSU 2nd Semester:

- No comment.
- None.
- Students being engaged and doing the science is much more meaningful and increases learning.
- It is possibly my administrator will ask me to lecture more this coming year.
- No comment.
- I'm not certain – I think my biggest limitation will be what equipment I have.

ESU 1st Semester:

- I can implement these changes, but sporadically throughout the year.
- All
- I plan to do all.
- All of them. I'll have more materials, background and experience to do so.
- No Comment
- None… I hope :)
- None
- Not sure money for chemicals for labs.
- ?
- None.

ESU 2nd Semester:

- Parts of Chem II will need to be supplemented.
- I will incorporate the Chem I materials, don't offer Chem II, and may offer Chem II independent study for advanced students.
- It will be difficult to model since biology modeling is not complete.
- Not sure
- None.

Question 9: **What is your top priority to implement this year from your workshop learning?**
FHSU 1st Semester:

- Modeling, whiteboarding
- Engage students
- Whiteboarding of anything! Just start having students do that. Educating people on use of LoggerPro.
- The modeling cycle.
- Physical science student review to prepare for science assessments.
- Whiteboarding.
- More graph analysis – students have difficulty with this.
- Modeling approach with labs.
- Socratic questioning. Labs, whiteboarding.
- Less lecture = more student engagement.
- Less lecture, more student engagement.
- Modeling, not using traditional book/note taking. Not giving students lab handouts.
- Implement more modeling.
- Modeling.
- Incorporate modeling, I'm new to this method.
- Whiteboard sessions.
- Whiteboarding = presenting.
- Whiteboarding.
- Increase the rigor and level of student conversations/work during the whiteboarding.

FHSU 2nd Semester:

- Try to incorporate modeling more and become more proficient in my technique.
- Whiteboarding.
- Electrostatics and capacitance

- I will not be able to implement the electrical unit. I need a second year physics class.
- I intend to mesh the E & M and CASTLE materials to increase the amount of electricity material covered this year!
- I plan on cutting out lecture as much as possible.

ESU 1st Semester:

- I'm going to implement modeling from the start. There are a few topics I will do without modeling, But I am excited about Modeling!
- White boarding sessions
- White boarding !!
- Modeling technique
- Switch to conceptual particle basis
- Asking appropriate questions.
- Strengthen the student's comprehension on basic concepts before introduction complex ideas.
- White boarding and using labs to uncover chemistry
- Modeling and more labs
- Try some white boarding at beginning of year liked units 1 and 2
- Incorporate modeling
- Lab opportunities, white boarding
- Increase lab time is probably number 1, but the white boarding for student understanding.

ESU 2nd Semester:

- Applying the process to a Chem classroom.
- Yes, better this year, we were able to get through the material plus work on new materials for addition to the curriculum. Would have like more direction from ESU as to where they would have liked us to go.
- Improved whiteboard sessions (better questioning techniques)
- White boarding and questioning techniques.
- Contact other science and Chem teachers that are local to me that I met during the workshop.

Question 10: **Was the duration of this workshop appropriate? Why or why not?**

FHSU 1st Semester:

- Yes.
- Yes. Last year, two weeks just didn't feel like enough to get comfortable with the material and process.
- Yes, two weeks would have been too crammed.
- No comment.

- Yes. At this point, I'm tired and have a great desire to quietly think about what I have learned and start developing specific student activities for modeling.
- Too long for me – labs began to get turned around in my head.
- No, but I think it was not designed this way. The incorporation of both middle and high school teachers caused the workshop to stall.
- No, needs to be longer for the later units.
- Yes.
- Seemed very long, but lots of good info.
- Yes. Not too short, but didn't get sick of it either.
- Yes, we covered a lot of material but I don't think any more would help. Perfect.
- Yes.
- Yes.
- Yes.
- Yes. Two weeks = too short. 3 weeks is long, but good.
- Yes, although I would recommend 5 days/week.
- Duration was fine.
- Yes because it allowed time to experience and see the modeling cycle. I know of at least one participant who was "converted."

FHSU 2nd Semester:

- Yes, except I lost focus the last couple of days (it was definitely time to get home to family).
- Yes, appropriate.
- Yes.
- I like 3 weeks best.
- Yes!! 3 weeks seems to be the limit for the "stress" that the learning creates – any less and we don't learn enough any more and we shut down.
- I feel I learned more in 3 weeks than I could have in 2.

ESU 1st Semester:

- Long but necessary.
- Concentrates
- Length was good- M-Thurs is good
- Appropriate for what needed to be covered.
- Too short BUT! Can't really be longer to attract teachers so…GREAT
- Yes

- Fairly appropriate
- Yes and no… 3 weeks is a large chunk of the summer, but I would have loved more time to practice and process.
- Yes for the amount of information presented no because it killed my summer (LOL)
- Too long probably because over 1/2 my summer has been PD classes.
- It was long to be away from home-Wichita next year?
- Yes, less would have been too quick/ information overload more would have taken more of the summer.
- I think it just right under the circumstances.

ESU 2nd Semester:

- Yes, any longer would have interfered with school in-service.
- They were there when we needed them, they gathered additional materials when we needed them.
- Yes, we were able to finish getting through all the Chem II units.
- Yes
- A little long (3 weeks)
- Yes I felt I had time to absorb what to do.

Question 11: **Would you like to take a Modeling workshop again?**

Total number of teachers who responded "yes" or "probably":

FHSU 1st Semester Participant(s) reporting 18 (N = 19)
FHSU 2nd Semester Participant(s) reporting 6 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 18 (N = 22)
Participant(s) reporting at both universities 42 (N = 47), 90%

Total number of teachers who responded "unsure" or "no":

FHSU 1st Semester Participant(s) reporting 1 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 2 (N = 22)
Participant(s) reporting at both universities 3 (N = 47), 6%

Two ESU participants did not complete the survey. 4%

Question 12: **Comment on your workshop leaders and their role in accomplishing the goals of the workshop.**

FHSU 1st Semester:

- Great, thourghly enjoyed the learning process. It pushed my boundaries.

- Penny has been doing this for years and is obviously comfortable with the process. It seems to be a very natural way for her to teach and she modeled it very well in our class.
- I like Earl's questioning during whiteboard sessions to help students make connections. He demonstrated patience, as well as a demand for precision.
- They are excellent. Job well done.
- Penny – very knowledgeable and helpful; Earl – Full of ideas and energy; Paul – very enthusiastic; All – pleasure to work with.
- No comment.
- They rocked!
- Very happy at the approach.
- Don't be afraid to tell people to wait until end of the WB to discuss in teacher mode.
- Penny tried to keep us on track and helped me to make some connections as to how this will work in my classroom.
- Personable and able to keep us on task. Knowledgeable.
- Penny was great. She shared great ideas and labs that I can use in my class. Earl motivates me to be a better teacher.
- Well versed on modeling and they provided good examples from their own experience.
- No comment.
- No comment.
- No comment.
- Penny was phenomenal! Great job of steering a rambunctious group. Modeled the role of teacher very well!
- Penny and Earl are both great! Very knowledgeable.
- The workshop leaders exhibited skill and knowledge of physics. I think the "teacher-mode," "student-mode" issue did impact negatively due to some reticent teachers who did not wish to "act like" students.

FHSU 2nd Semester:

- Very good. Kayvan was great at explaining the theory and concepts.
- Very helpful.
- No comment.
- We were self directed but that was not enough. There needs to be a leader that knows modeling well and the curriculum too.
- Kayvan was an asset this year – and was "modeling" friendly.
- Kayvan was a little over my head, but, everyone seemed to really know their stuff.

ESU 1st Semester:

- Alan was great. He kept us on track and encouraged.
- Wonderful! Alan was a great role model.

- Excellent Job
- The leaders did an excellent job!
- Alan did a great job!
- Awesome- supportive-patient, but HONEST
- Alan Vancil was fantastic and is a great help to a young teacher.
- Very efficient, effective, friendly and accommodating.
- Alan did an excellent job! He was always available and willing to help; an amazing leader.
- Alan is a fabulous teacher highly knowledgeable in chemistry and modeling.
- Good- Alan and Dr. Davies, Not Good - Earl-making comments that the facilitator had already covered- lack of communication.
- Alan was EXCELLENT- taught as he told us to do.
- Again, Alan Vancil did a great job! Very insightful!
- The facilitator did an outstanding job.

ESU 2nd Semester:

- We could have used more instruction from some units we were working on.
- The leaders were great but may need to be more involved with the process. Earl L. arrived for the 3rd week and was instrumental for focusing our efforts.
- Great Job with this! I did learn a lot!
- We had to self-lead ourselves which was frustrating!

Question 13: **To what extent did you find each of these workshop components valuable?**

Laboratory Activities:

Total number of teachers who rated the laboratory activities a 10, 9, or 8:

FHSU 1st Semester Participant(s) reporting 19 (N = 19)
FHSU 2nd Semester Participant(s) reporting 6 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 17 (N = 22)
Participant(s) reporting at both universities 42 (N = 47), 90%

Total number of teachers who rated the laboratory activities a 7, 6, or 5:

FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 1 (N = 22)
Participant(s) reporting at both universities 1 (N = 47), 2%

Total number of teachers who rated the laboratory activities a 4 and under:
FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 1 (N = 22)
Participant(s) reporting at both universities 1 (N = 47), 2%
Three ESU participants did not complete the survey. 6%

Whiteboards:
Total number of teachers who rated the whiteboards a 10, 9, or 8:
FHSU 1st Semester Participant(s) reporting 17 (N = 19)
FHSU 2nd Semester Participant(s) reporting 5 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 16 (N = 22)
Participant(s) reporting at both universities 38 (N = 47), 81%
Total number of teachers who rated the whiteboards a 7, 6, or 5:
FHSU 1st Semester Participant(s) reporting 2 (N = 19)
FHSU 2nd Semester Participant(s) reporting 1 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 2 (N = 22)
Participant(s) reporting at both universities 5 (N = 47), 11%
Total number of teachers who rated the whiteboards a 4 and under:
FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 2 (N = 22)
Participant(s) reporting at both universities 2 (N = 47), 4%
Two ESU participants did not complete the survey. 4%

Class Discussions (participants and leaders):
Total number of teachers who rated the class discussions a 10, 9, or 8:
FHSU 1st Semester Participant(s) reporting 13 (N = 19)
FHSU 2nd Semester Participant(s) reporting 6 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 18 (N = 22)
Participant(s) reporting at both universities 36 (N = 47), 77%
Total number of teachers who rated the class discussions a 7, 6, or 5:
FHSU 1st Semester Participant(s) reporting 6 (N = 19)

FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 2 (N = 22)
Participant(s) reporting at both universities 8 (N = 47), 19%

Total number of teachers who rated the class discussions a 4 and under:
FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 0 (N = 22)
Participant(s) reporting at both universities 0 (N = 47), 0%

Two ESU participants did not complete the survey. 4%

Printed Materials:

Total number of teachers who rated the printed materials a 10, 9, or 8:
FHSU 1st Semester Participant(s) reporting 19 (N = 19)
FHSU 2nd Semester Participant(s) reporting 5 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 13 (N = 22)
Participant(s) reporting at both universities 37 (N = 47), 94%

Total number of teachers who rated the printed materials a 7, 6, or 5:
FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 1 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 7 (N = 22)
Participant(s) reporting at both universities 1 (N = 47), 2%

Total number of teachers who rated the printed materials a 4 and under:
FHSU 1st Semester Participant(s) reporting 0 (N = 19)
FHSU 2nd Semester Participant(s) reporting 0 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 0 (N = 22)
Participant(s) reporting at both universities 0 (N = 47), 0%

Two ESU participants did not complete the survey. 4%

Logs/Journal Reflections:

Total number of teachers who rated the log/journal reflections a 10, 9, or 8:
FHSU 1st Semester Participant(s) reporting 12 (N = 19)
FHSU 2nd Semester Participant(s) reporting 3 (N = 6)
ESU 1st & 2nd Semester Participant(s) reporting 4 (N = 22)

Participant(s) reporting at both universities 19 (N = 47), 41%

Total number of teachers who rated the log/journal reflections a 7, 6, or 5:

FHSU 1st Semester Participant(s) reporting 7 (N = 19)

FHSU 2nd Semester Participant(s) reporting 3 (N = 6)

ESU 1st & 2nd Semester Participant(s) reporting 12 (N = 22)

Participant(s) reporting at both universities 22 (N = 47), 47%

Total number of teachers who rated the log/journal reflections a 4 and under:

FHSU 1st Semester Participant(s) reporting 0 (N = 19)

FHSU 2nd Semester Participant(s) reporting 0 (N = 6)

ESU 1st & 2nd Semester Participant(s) reporting 3 (N = 22)

Participant(s) reporting at both universities 3 (N = 47), 6%

Three ESU participants did not complete the survey. 6%

Question 14: **What is the most important change you would make to improve this workshop?**

FHSU 1st Semester:

- No comment.
- I really think the middle school teachers would benefit more by being in their own group. Simply not knowing the material slowed the class down tremendously.
- Incorporate how to select presenters to tell a story during the whiteboard presentations mentioned but not sure if this was demonstrated. Establish norms of behavior and adhere to them: patience with students; texting, eating, etc.; student/teacher mode thing. Model how to use the unit organizer to capture learning.
- No comment.
- No comment.
- Less info.
- Separate out middle school and high school teachers (physics first vs. regular, maybe).
- Split into middle school/high school – middle school does not get into/need the full range that high school covers or expected to cover. Better living quarters – I know cheap was chosen to provide more to the project, but the problems were incredibly distracting.
- Allow nuts and bolts discussions – time to incorporate stages other teachers have done – what worked well and how you changed it to meet needs of your students.
- More articles, less worksheets?
- Participants there not to theorize, but to learn.
- Break up middle school and high school.

- Whiteboarding to get students to talk about physics and help each other.
- Define student mode/teacher mode early.
- No comment.
- Don't spend so much time on nit-picky "teacher mode" moments. Some is good – but it shouldn't take hours to go through 1 sheet.
- Shorten time to whiteboard, at least if conversations go off topic. Seemed to be some opportunity to gain some time there.
- Add something about strategies to get districts/schools to adopt modeling.
- Introduce some structures at the beginning to provide guidance for the participants. Establish norms of behavior – standards that participants agree to. Then we post them and can refer to them. Example of norms are: be respectful; agree to disagree; etc.

FHSU 2nd Semester:

- Unsure how to improve.
- More money to buy physics equipment.
- No comment.
- We need to have a leader that has a deep understanding of modeling!!
- More detailed agenda written to fit the time frame for our workshop – However the freedom to "re-structure" according to our needs and interest was a valuable asset.
- It would be nice to have more equipment to take home and use with our students.

ESU 1st Semester:

- ??
- Have each participant lead one board discussion(maybe not a whole session- just a board!)
- none
- Put notebook in order so there is no confusion; more time for labs/wb (longer workshop?); remove journal reflections (they take away from practice and collaboration on course materials outside of class)
- Make it more specific to other areas that need modeling too (not just Physics and Chemistry for High School)
- Advertised as chemistry modeling then believe all participants should be planning on teaching chemistry segment at the high school level
- Although journals and reflections had good content, they took away time that could have been better used. Plus this led to too much homework the first weeks.
- Have the participants load LoggerPro on their computers before the workshop starts.

ESU 2nd Semester:

- Offer the Physics course here at ESU.

- A peer leader would be helpful thought the process.
- A little more instruction in the beginning would be helpful.
- Make Chem II focus more on questioning techniques and white boarding, it was why I took the course and I was disappointed that we didn't.