Early Development of a Student-Centered Perspective in Science and Math Pre-Service Teachers

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Abstract

This pilot study investigates the influence of instructor modeling on future math and science teachers' student-centered perspective as evidenced in planning classroom lessons. The lesson plans of twenty-seven credential students with no experience in student-centered classroom instruction were compared to lesson plans by five pre-service students and twenty-one undergraduates with such experience. An analysis of variance finds a significant difference in the student-centeredness of the lesson plans of the credential students compared to the other two groups but no significant difference between the pre-service students with prior experience and the undergraduates. After ten weeks of instruction, fifteen of the credential students also completed a survey that included questions about teacher practices, student objectives, and different classroom discussion scenarios. All of the students indicated that they would use student-centered approaches and seem to have developed an inclination toward reform-based pedagogy.

Background

In its bellwether study "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Future," the National Academy of Sciences (2007) highlighted the critical shortage of highly qualified science and math teachers in the United States, and called for states and teacher preparation programs to annually recruit as many as 10,000 new secondary science and math teachers nationwide, with an emphasis on scholarship incentives and integrated 4-year university programs leading to bachelor's degrees in the physical or life sciences, mathematics, computer science, or engineering along with concurrent teaching certification. In response to this critical shortage, campuses of a California university system launched the California Teach Science and Math Initiative. A common component across campuses has been the development of seminars to attract undergraduates to a science or math teaching career and to provide an early introduction to the profession and to the teaching and learning of math and science through structured seminars and classroom fieldwork experiences. A series of three such seminars have been developed, with an emphasis on recruiting future teachers, as well as providing early understanding of the teaching and learning of math and science, both through the courses and through accompanied fieldwork.

One important idea that is introduced and reinforced across all three of the seminars is that of a "student-centered" perspective to teaching, which is advocated in reform-based approaches to science and math education (National Research Council, 1996). Research shows that pre-service and novice teachers often start off with a teacher-centered perspective (Dunn, 2005); however, teacher preparation or teacher in-service experiences can be structured to activate a shift in teachers' thinking and instructional practice that adopts a student-centered perspective. This study examines several key questions about the shift from a teacher-centered to a student-centered perspective by prospective teachers who have completed two of the seminars and related field experience:

(1) Among three comparison groups of aspiring math teachers, will those individuals with some prior exposure to the modeling of reform-based math education practices, and some introductory experience with lesson planning and delivery based on those reform-based ideas,

apply their knowledge any differently to a lesson planning task, compared to individuals with no similar prior experience?
(2) At the conclusion of the two seminars and classroom fieldwork (and prior to starting other math and science education coursework in the teacher credential program), what are some indicators of a student's adoption of a student-centered approach to teaching?
(3) How effective are the study's data instruments (embedded assessments in the seminars) and coding schemes at identifying elements of a student-centered perspective in these prospective teachers?

The type of fieldwork-based seminars described in this study provide an early recruitment and career exploration mechanism to attract a greater number of science and math majors to the teaching profession. However, this study's seminar intervention seeks to address the issue of teacher quality as well. It examines how even early experiences prior to starting other teacher preparation curricula can be designed to affect some early shifts in individuals' thinking about teaching as a student-centered practice.

Theoretical Framework

The National Science Education Standards (National Research Council, 1996) advocated a teaching approach that shifts away from a behaviorist philosophy of teacher as information provider (teacher-centered instruction) using one way communication of facts and vocabulary to a mostly passive audience of students (Lee & Avalos, 2002), toward a more sociocultural philosophy of learning in that students co-construct meaning through active participation in investigations, interactive discussion and questioning (student-centered instruction). Teacher-centered classrooms are characterized by rote practices, whole class instruction through lecture, text and demonstration with little to no interaction between the teacher and the students (Osisioma & Ndunda, 2007). The focus is on student acquisition of facts rather than on student understanding and use of scientific knowledge and ideas. In these traditional settings, students are often disengaged from the lesson. In student-centered classrooms, students have opportunities for scientific discussion, apply concepts to real world settings and to solving problems, and the instruction is adapted to meet their needs (Brand & Wilkins, 2007). Perrone (1997) proposed that children need to make meaning for themselves and that "teaching is not telling (p. 638)".

Researchers (Peterson, Clark, & Dickson, 1990; Reynolds, 1995; Perrone, 1997; Wideen, Mayer-Smith, & Moon, 1998; Zeichner, 1999; Beeth & Adadan, 2006; Brown & Melear, 2006; Craven & Penick, 2001; Roth & Tobin, 2001; Hiebert, Gallimore, & Stigler, 2002) have described the disconnect perceived by prospective teachers between the knowledge acquired in university-based courses and their field experiences. Prospective teachers do not recognize the usefulness of the educational theory they acquire in their undergraduate education courses or in their credential programs to their experiences in real classrooms working with real students. Yet Beeth and Adadan (2006) noted that classroom experiences and university coursework might have complementary roles in preparing prospective teachers. One provides the wisdom of practice while the other provides the theoretical background. Yager (1991) and Hiebert, Gallimore, & Stigler, (2002) suggested that prospective teachers be taught about student-centered instruction using constructivist strategies that incorporate active learning and classroom discussion so that they might understand the techniques used in this type of instruction. Too often students received lectures by university faculty telling them about student-centeredness! Sherman and MacDonald (2007) found in their interviews with preservice teachers that these prospective teachers had not had positive, engaging experiences in science as children so they could not envision what student-centered instruction looked like. Their pre-conceived notions affected their beliefs about their own science teaching. Sherman and MacDonald (2007) provided science experiences as learners for their preservice teachers so they could develop an understanding of the role of the learner as well as the role of the teacher. Tobin and Fraser (1990) suggested that prospective teachers explore pedagogy in an active learning environment, using the processes of dialogue, developing meaningful tasks, and giving explanations as a model of student-centered instruction. Reynolds (1995) concluded that without appropriate education and mentoring, beginning teachers would not be able to create rich environments that promote learning for all students.

Bransford and Donovan (2005) proposed that effective classrooms are:

- learner-centered in that the teacher acknowledges the knowledge and understanding that students bring to the classroom. Teachers in these classrooms engage students in activities by first accessing their prior knowledge. These teachers view students as active processors of information who assimilate new facts and concepts into their pre-existing frameworks.
- knowledge-centered in that students investigate phenomena to acquire understanding of relationships and concepts. Teachers focus on students acquiring information then applying that information in real world contexts.
- assessment-centered in that teachers engage in formative and summative evaluations of student learning to drive their instruction and students engage in self-evaluation of their own learning.
- community-centered in that effective classrooms are learning communities where students are respected and questioning and risk-taking are expected. Students discuss ideas with each other in small groups and in large groups and they also discuss ideas with the teacher.

The classrooms they describe exemplify ideal student-centered learning environments.

To be effective in preparing future teachers, Haberman (1995) suggested five principles of excellence regarding the expertise of teacher educators:

- "Since the essential expertise required of future teachers is relevant, usable, know-how in teaching children/youth, the majority of the teacher education faculty, in any program, should be experienced, currently practicing classroom teachers who have been identified as effective.
- Teacher educators are practitioners whose scholarship derives primarily from an experiential knowledge base of what works in classrooms in the real world; they are expert at evaluating ideas from whatever source (state mandates, expert opinion, administrative policy, research, or theory) in terms of its effects on children/youth in classrooms.
- Teacher educators are expert teachers of low-income, minority and culturally diverse constituencies of children /youth in need of the best teachers.
- Teacher educators are capable of coaching candidates' actual teaching behavior and of modeling best practices for them in actual classrooms.

- Teacher educators are knowledgeable, currently practicing teachers who can prepare candidates for the non-teaching, school-wide, and community responsibilities of teachers in the real world. (p. 32)"

Another means by which pre-service teachers can be better prepared to be effective teachers is through fieldwork. Dunn (2005) and Beeth and Adadan (2006) described the influences of field experiences on the beliefs of preservice teachers regarding effective teaching strategies. Being in actual classrooms and observing teacher-student interactions made the prospective teachers more aware of the negative impact of traditional transmission models of teaching (teacher-directed) compared to nontraditional (student-directed) teaching that engages the students in authentic discussion and active meaning-making. Roth and Tobin (2001) suggested that mentor teachers be overt in their conversations with students about their teaching practices. They noted that not all field experiences have positive effects on prospective teachers.

This study seeks to learn if these opportunities can successfully occur before a credential program.

Methods

This pilot study employed a variable treatment design to assess the degree to which pre-service teachers utilize a "student-centered" approach in their instruction. In student-centered classrooms, students apply concepts to real world settings and to solving problems, and the instruction is adapted to meet their needs (Brand & Wilkins, 2007; D'Ambrosio, Johnson, & Hobbs, 1995; Johnson, Kahle, & Fargo, 2007; Colburn, 2007). During instruction, students co-construct meaning through active participation in investigations, questioning, and interactive discussion with the teacher and other students. Active learning by students involves describing objects and events, asking questions of the teacher and each other, thinking of explanations, testing hypotheses, and communicating their ideas to others.

Study Personnel

Two of the researchers served as the co-instructors for all the courses described below as treatment. These two researchers also serve as co-directors for the math and science subject matter projects at UC Irvine. In this role, the researchers conduct professional development and work with local, low-performing school districts. Both of these researchers spent years as effective secondary school math and science teachers in low-performing school districts, before coming to UC Irvine. In addition, these two researchers supervise student or intern teachers and are regularly in K-12 classrooms. The third researcher serves as Staff Director for the UCI California Teach program. The final researcher served in an academic counseling capacity for all participants in the treatment group through her roles as Co-Director for the California Math and Science Teaching Initiative, and Associate Director for the Science and Math Initiative program from January 2006-August 2007.

Participants—Treatment Group

A total of 26 participants (22 females; 4 males) are included in the "treatment group." All treatment group members completed at least two seminar courses with corresponding fieldwork in the University of California Science and Math Initiative (SMI), or one seminar course with corresponding fieldwork in the California Math & Science Teaching Initiative (CMST)—two programs that are sponsored by the UC Office of the President to significantly increase the number of highly qualified math and science teachers for the state. The ethnic breakdown of the treatment group was as follows: 38% Asian, 23% Caucasian, 23% Latino, 8% Filipino and 8% African-American. Participants in the treatment group were classified as sophomores, juniors, seniors, or credential-level (graduate) students at the time of the study. All (n = 26) participants self-selected into the treatment group by enrolling in an "Introduction to Math and Science Teaching" seminar course offered by the University. A description of the treatments provided follows in the next section. Participants who received treatment will be referred to as "Pre-service-Prior Experience" and "Undergraduate-Prior Experience" in the results section.

Non-treatment group

A total of 27 participants (14 females; 13 males) were included in the non-treatment group. The ethnic breakdown of the non-treatment group was as follows: 44% Asian, 41% Caucasian, 4% Latino, and 11% other or "decline to state." The non-treatment group was comprised entirely of credential (graduate-level) students. Although non-treatment group members did not participate in the SMI or CMST seminars previously described, it is possible that they participated in similar experiences elsewhere, and this will be considered in the study analysis.

Treatments

The University of California sponsors two statewide programs (CMST and SMI) to significantly increase the number of highly-qualified math and science teachers in the state's public schools. These programs were established on the Irvine campus in 1997 and 2006, respectively. From 1997-2005, the CMST program consisted of one seminar course in math and science teaching, with a corresponding classroom field experience in a middle or high school. With the advent of SMI in 2006, the CMST course/field experience was replaced by three quarter-long seminar courses with corresponding classroom field experiences at the elementary, middle, and high school levels. A total of 6 treatment-group participants were exposed to the treatment under the old CMST course/field experience, which was designed and instructed by the same faculty members who developed the 3-quarter SMI seminar/fieldwork experience. The remaining 20 members of the treatment group participated in the first two SMI seminars/fieldwork experiences during the 2006-07 academic year.

The subjects in the treatment group received two major treatments: seminar and classroom field experience. These treatments occurred simultaneously. Participants who enrolled in the CMST seminar met 1.25 hours per week for ten weeks, and completed 40 hours of fieldwork in a middle or high school math or science classroom. Participants who enrolled in the two SMI seminars met for 5-6 three-hour sessions, and completed at least 20 hours of fieldwork at the elementary and middle school levels, per quarter. All SMI seminar students were placed in elementary classrooms with teachers who were active participants in math and science professional development sponsored by the UCI Center for Educational Partnerships. Undergraduates placed in secondary classrooms were frequently assigned to teachers who were active in this professional development, but not in every case. Samples of course syllabi are included in Appendix A.

The CMST seminar was divided into two sections: sharing and analysis of fieldwork experience and math and science pedagogy. Prior to the start of each weekly seminar, students would complete journal entries related to the day's topic which they could answer from their fieldwork experience. Topics included standards and standardized testing, questioning, engaging and supporting all learners, creating and maintaining an effective learning environment, assessment, making subject matter comprehensible and lesson design. Students enrolled in the CMST seminar completed 40 hours of fieldwork in a local, low-performing middle or high school. Upon completion of the 40 hours, students were eligible to continue fieldwork for salary. Students were required to complete journal reflections of their experiences bi-weekly for the remainder of the time they completed CMST fieldwork.

The SMI seminars were divided into three parts: discussion and analysis of experiences from the fieldwork, math and science teaching theory, and hands-on math and science lessons. For approximately 1-1.5 hours of each seminar meeting, the instructors modeled effective teaching pedagogy while discussing instructional strategies/issues. In the first seminar course, major topics included: working with elementary students, standards, testing and accountability, questioning, types of knowledge, 5 E lesson design and the Peer Classroom Observation Protocol (PCOP), which examines student involvement, student engagement, cognition and teaching tools and strategies. For the second seminar, major topics included: textbooks and teaching for conceptual understanding, assessing student learning, student error and discourse, motivation and classroom management and working with special populations (i.e. English language learners and special needs students). During the seminars, students complete assignments related to the weekly topics; these assignments include reading and analyzing research articles, journal reflections, a lesson plan and reflections.

The remaining portion of SMI seminar meetings was devoted to having undergraduates "practice" hands-on, conceptual learning that occurs in a classroom. Many of the lessons used were developed by the instructors for teacher professional development, and all include research-based methodologies. The activities are California standards-based, and as such, seminar members were divided up to complete activities appropriate for the grade levels they were working with in their field experiences. After participating in these activities, the seminar students would discuss and analyze them through the lens of a teacher (i.e. putting their "teacher" hats on). It was the intention of the instructors that participating in these "student-centered" lessons will provide examples from which the students can model the lessons they write.

Towards the end of each seminar, students wrote a "5-E lesson plan" which was reviewed by the instructors, and then delivered by the undergraduates during their fieldwork. The math and science lessons were written in the 5 E learning cycle lesson format suggested by Bybee (1997): Engage, Explore, Explain, Evaluate, and Extend. When lessons are written in this format, they are student-centered in that the student has an active role in each component, promoting oral and written discourse. In Engage, the learner accesses prior knowledge (Bransford, Brown, and Cocking, 2000) while capturing the learner's attention, placing the learner into the context of the subject matter, stimulating thinking, and raising questions in the learner's mind. In Explore, the learner has the opportunity to observe, record data, interpret results, and organize findings. Often, the learner uses manipulatives in purposeful hands-on learning experiences, supporting English Learners as they use oral and written language to describe their findings (Herrell, 2000; Jarrett, 1999). In the Explain phase of the learning cycle, the learner finds patterns based on the data while using academic vocabulary. Students explore before they use vocabulary words so that they have experiences and mental images to which to attach their terminology. In Evaluate the learner has an opportunity during formative and summative assessment to show what he/she knows through oral and written language as well as drawings. Through Extend the learner makes connections to the real world or to other curricular areas such as literature and music to facilitate transfer of learning.

As with the CMST seminar, SMI seminar students had the opportunity to complete up to 60 hours of additional fieldwork at their school sites. Stipends were awarded for completing extra hours.

Instruments & Procedure

Two instruments were designed for use in this pilot study. The first is a rubric designed to measure the degree to which a lesson design is student-centered versus teacher-centered. The rubric is based upon the research of Schwab (1962) and Herron in making subtle shifts towards inquiry, Garrison and Amaral (2006) and Tsai (2007). The rubric has 6 domains: The Intent of the Lesson; Student Interest and Prior Knowledge; Data, Claims and Evidence; Teacher Role during the Lesson; Student Role and Engagement; and Group Size and Purpose. Each domain is scaled from 1-4, with 1 = *completely teacher-directed* and 4 = *completely student-centered.*

The rubric was used to analyze lesson plans submitted by the participants. For the 20 undergraduate students, these lessons were submitted during the 2006-07 school year, while enrolled in the second SMI seminar. For the math credential students, the lesson was a pre-class assignment submitted in September 2007 before beginning credential coursework. The rubric was pilot-tested by the group of researchers and revised in areas where the language was unclear. The group of researchers then independently scored an additional 5 papers to ensure inter-rater reliability. At this point, it was decided that the two researchers with math and science teaching experience would be best suited to score the lesson plans. These two researchers independently scored the remaining lesson plans and came to consensus on each student's scores. The undergraduates' lessons were coded and the names blacked out to ensure anonymity and to avoid any bias on the part of the instructor/researchers. The lessons were Word documents so identifying handwriting was not an issue. The rubric is included in Appendix B.

The second instrument for this pilot study was a survey, also intended to measure the degree to which a pre-service teacher holds student-centered perspectives in their approach to teaching. This survey was developed using questions from both the 2000 National Survey of Science and Mathematics Education (Westat), the Teacher Pedagogical Philosophy Interview (Brown & Melear, 2006), and the Teaching Learning, and Computing: 1998 survey (Anderson and Becker, 2001). The survey was piloted with a group of students just entering the SMI program who were not part of this study. Results were analyzed to ensure the survey would allow for a range of responses. The researchers modified the survey to include additional questions that would be analyzed with a reverse scale. This decision was made, in part, because the participants were also students of the researchers and might be tempted to answer all "4's" to please their instructors. The survey was distributed to the subjects for them to complete on their own time. The survey is included in Appendix C.

Results

Lesson Plan Analysis

The lesson plan analysis was designed to answer the following question: Among three comparison groups of aspiring math teachers, will those individuals with some prior exposure to the modeling of reform-based math education practices, and some introductory experience with lesson planning and delivery based on those reform-based ideas, apply their knowledge any differently to a lesson planning task, compared to individuals with no similar prior experience? The following describes the different levels of experience for the three comparison groups:

1) Pre-service-No Prior Experience
   This group was comprised of twenty-seven pre-service math teachers newly enrolled in a teacher preparation program, who had no significant prior exposure to reform-based pedagogy or lesson planning even though they had all taken at least one education course before enrolling in their credential program. They all indicated in their survey that they each had had some kind of fieldwork experience, either tutoring, coaching, informal education (museum or nature center), or classroom. These individuals completed this study's lesson planning task as an introductory assignment in their pre-service methods course, at the very beginning of the program year, just prior to formal instruction about pedagogy and lesson planning. Two subjects in this group did not complete a lesson plan.
2) Pre-service-Prior Experience
   This group was comprised of five pre-service math teachers newly enrolled in the same teacher preparation program, who had prior exposure to the modeling of reform-based pedagogy and lesson planning practice in an undergraduate introductory math education course completed one to two years prior to entering the pre-service teacher program at the university. Like the individuals in the "Pre-service-No Prior Experience" group, these aspiring teachers completed this study's lesson planning task as an introductory assignment in the same methods course, at the very beginning of the pre-service program, just prior to formal instruction about pedagogy and lesson planning.
3) Undergraduate-Prior Experience
   This group was comprised of twenty-one undergraduate aspiring teachers (not yet enrolled in a teacher preparation program), who enrolled in an introductory math education course, where they were exposed to the modeling of reform-based pedagogy and lesson planning. These individuals completed this study's lesson planning task as a final assignment for that course. Lesson plans for four of these subjects were not available for scoring.

Using the lesson scores assigned to each subject for six different domains of student-centeredness, an analysis of variance was conducted to identify any significant differences in the performance of the three comparison groups. The between-groups comparison revealed a statistically significant main effect for level of experience, $F(2,47) = 9.054$, $p = .001$; the Pre-service-No Experience group scored significantly lower than the other two groups on all six domains. There were no statistically significant differences in mean lesson plan scores for student-centeredness between the Pre-service Prior Experience group and the Undergraduate-Prior Experience group. See Table 1 for a summary of mean scores.

The analysis of lesson plan data also revealed a statistically significant within-group effect for differences between different domain scores, $F(5, 47) = 8.234$, $p = .000$. A post-hoc analysis showed the most robust difference for scores in domain 5 (a measure of student-centeredness in the planning of student roles and engagement), which had a significantly higher mean value than all of the other mean domain scores. Regardless of level of experience, the aspiring teachers in this study did a better job of applying a student-centered stance toward planning active student engagement in their lesson plans relative to their lesson plan performance with the other domains.

Table 1
Comparison of Mean Scores for Student-centeredness on a Lesson Planning Task

Group	**Domain 1**	**Domain 2**	**Domain 3**	**Domain 4**	**Domain 5**	**Domain 6**	**Mean across all domains**
Pre-service-No Prior Experience (n=25)	2.08	1.88	1.56	1.72	2.20	1.60	1.84* **
Pre-service-Prior Experience (n=5)	2.80	2.60	2.20	2.20	2.80	2.20	2.47
Undergraduate-Prior Experience (n=17)	2.29	2.29	2.12	2.35	2.71	2.35	2.35
Mean across all 3 groups	2.23	2.11	1.83	2.0	2.45	1.94	

Note. Scores were based on a 4-point scale of 1 (least student-centered) to 4 (most student-centered). * Group main effect $p < .05$ for contrast between Pre-service-No Prior Experience and Pre-service-Prior Experience. ** Group main effect $p < .01$ for contrast between Pre-service-No Prior Experience and Undergraduate-Prior Experience. The six student-centeredness scoring domains are: 1) Intent of lesson; 2) Student interest and prior knowledge; 3) Data, claims, and evidence; 4) Teacher role during the lesson; 5) Student role and engagement; and 6) Group size and purpose.

Accordingly, the results of the lesson data analysis provide an affirmative answer to the research question posed above. Both the undergraduates who had learned about reform-based practices and lesson planning, as well as the pre-service teachers who had learned about these things 1-2 years earlier, applied that knowledge and understanding to written lesson plans that were analyzed for this study, resulting in student-centeredness mean scores that were statistically higher than the mean scores for pre-service teachers who had not had the same prior experience even though these students had had at least one education course before submitting their lesson plan. The no-experience group was not without models on which to draw; their scores showed that they were more apt to draw on their past knowledge of non-student-centered approaches to teaching in this study's lesson design task. It is interesting that the mean scores for the Pre-service-Prior Experience group were not statistically different from the Undergraduate-Prior Experience group, even though for the former, some time had elapsed between participating in an introductory math education course and completing this study's lesson task. They were still able to draw on that prior knowledge, evidenced by the non-significant difference of their student-centeredness scores in relation to the scores of the undergraduates who were enrolled in the math education course at the time of the study. However, it is also important to note that the mean group scores across all three groups (ranging from 1.84 to 2.35 out of a possible 4) suggest that as novices, all of these aspiring teachers have room for growth in their understanding and application of student-centered pedagogies.

Survey Analysis

While the lesson plan task in this study provided an opportunity to examine how aspiring teachers applied their understanding of ideas about student-centered pedagogies to the actual practice of designing a lesson, the survey task in this study afforded an examination of aspiring teachers' judgments about their own use of a range of classroom practices. This phase of the study compared just two of the three groups described earlier: the Pre-service-No Prior Experience group and the Pre-service-Prior Experience group. Both pre-service teacher groups completed the survey during the tenth week of their mathematics methods course in a teacher preparation program. While the intended research design was to collect the survey data at the start of the teacher preparation program before the Pre-service-No Prior Experience group received any pedagogical instruction, this was not possible. Accordingly, we present the analysis of the survey data with full knowledge that both groups had had some exposure to ideas of reform-based pedagogies during the teacher preparation math methods course, prior to completing the survey. However, the Pre-service-Prior Experience group had a greater and more prolonged amount of exposure to these ideas because of their earlier participation in the undergraduate math education course. In the following report of survey analysis results, the names of the two comparison groups have been changed to "Pre-service-Less Prior Experience" and "Pre-service-More Prior Experience." Another characteristic of the survey data that limits our interpretations of its results is the small sample size of 15, because not all of the pre-service teachers turned in a survey.

Accordingly the analysis of the survey questions was designed to provide some initial insight about a research question that reflected this constraint that both groups had been exposed to some reform-based pedagogies: will those individuals with more prior exposure to the modeling of reform-based math education practices (as undergraduates and as pre-service teachers) apply their knowledge any differently to survey responses, and demonstrate a greater affinity for student-centered approaches to teaching, compared to individuals with less prior exposure to that type of modeling?

Several analyses of variance were done to identify any significant differences in survey performance of the two comparison groups. The survey questions were grouped into three different categories for three separate analyses:

a) Survey Category 1: Questions about teacher practices that elicited one of four ranked responses ranging from 1 (respondent will seldom do this as a teacher) to 4 (respondent will consistently do this);
b) Survey Category 2: Questions about student objectives that elicited one of four ranked responses ranging from 1 (respondent would place little or no emphasis on this as a student objective) to 4 (respondent would place a heavy emphasis on this as a student objective); and
c) Survey Category 3: Questions about descriptions of two different classroom discussion scenarios representing a less student-centered approach and a more student-centered approach. Respondents selected one of four responses indicating

their tendency to favor one class discussion scenario or the other: “definitely that approach,” “tend toward that approach,” or “can’t decide.”

Additionally, every survey question was categorized as belonging to one of two groups: questions about approaches characterized as student-centered, and questions about approaches characterized as more conventional (not student-centered). In each analysis of variance, data was examined for between-subject effects reflecting group performance differences, and within-subject effects reflecting differences in respondents’ answers to questions about student-centered approaches versus questions about more conventional approaches.

For both survey categories 1 and 2, there was a statistically significant main effect for the within-subject comparison of individuals’ responses to questions about student-centered approaches versus responses to questions about non-student-centered approaches. Regardless of membership in one subject group or the other, all pre-service teachers rated their inclination to use student-centered approaches more highly in relation to their inclination to use non-student-centered approaches (Category 1: $F(1,15) = 9.724$, $p = .008$; Category 2: $F(1,15) = 44.397$, $p = .000$). All respondents differentiated between the two types of approaches, and appeared to have begun to develop a disposition somewhat favorable to student-centered approaches over more conventional approaches. Tables 2 and 3 provide details about respondents’ mean survey ratings for these two categories. Scores for category 1 responses (different types of teacher practices) drew mean ratings of 2.9 for student-centered approaches, indicating an average inclination to use these approaches sometimes to often. Mean scores for category 2 (different student objectives) drew higher mean ratings of between 3.4 and 3.5 for more student-centered objectives, indicating an average inclination to give those approaches moderate to heavy emphasis. We can cautiously say that for our small sample, all of the pre-service teachers, who all had some degree of exposure to ideas of reform-based practices at the time of the survey, were receptive to saying that they would adopt these pedagogies themselves, and somewhat more receptive to adopting student objectives that reflected these practices.

Table 2
Comparison of Mean Survey Ratings of Student-Centered Teacher Practices (Category 1)

Group	**Questions about Student-Centered Approaches**	**Questions about Conventional Approaches**	**Mean across all Questions**
Pre-service-Less Prior Experience (n=11)	2.994	2.608	3.084
Pre-service-More Prior Experience (n=4)	2.987	2.350	2.970
Mean across both groups	2.992**	2.539**	

Note. Scores were based on a 4-point scale of 1 (least inclined to use an approach) to 4 (most inclined to use an approach). ** Within-subject main effect $p < .01$ in contrast between questions about student-centered approaches and non-student-centered approaches.

Table 3
Comparison of Mean Survey Ratings of Student-centered Objectives for Students (Category 2)

Group	Questions about Student-Centered Approaches	Questions about Conventional Approaches	Mean across all Questions
Pre-service-Less Prior Experience (n=11)	3.455	2.613	3.035
Pre-service-More Prior Experience (n=4)	3.585	2.375	2.980
Mean across both groups	3.490***	2.550***	

Note. Scores were based on a 4-point scale of 1 (least inclined to emphasize an objective) to 4 (most inclined to emphasize an objective). *** Within subject main effect $p < .001$ in contrast between questions about student-centered objectives and non-student-centered objectives.

As for the research question about group differences, the analyses of variance for all three survey categories resulted in no significant between-group main effects for mean survey ratings, which is somewhat expected given the problematic timing of the survey and the small sample size. However, a closer look at the mean values in the individual cells of Tables 2 and 3 offer a hint of a trend that might be revealed to be significant if the authors were to do a future study with a larger sample size.

Findings

This study sought to learn if modeling of reformed-based pedagogy with undergraduate students would lead to an significant increase in their student-centered approach to teaching. Data show a clear difference in lesson design between those students who had received this modeling through math education courses and those who had not. Both undergraduate and pre-service teachers who received this instruction designed lessons which were significantly more student-centered than their pre-service peers. As all participants in this study had some education coursework as well as some type of fieldwork prior to designing the lessons which were analyzed, the only noticeable difference between the treatment and non-treatment groups is the treatment described. Thus, the study results tentatively show that modeling of reform-based instructional practices in undergraduate education coursework leads to students adopting and applying a student-centered perspective in their teaching. It is also worthy to note that the instructors of the courses met the 5 principles suggested by Haberman's (1995) research.

This study also sought to learn what indicators one could look for in undergraduates to measure their adoption of a student-centered approach to teaching. While both groups of students scored similarly on the survey, there was significant difference in lesson planning. This causes the researchers to believe that lesson plans and the created rubric are good measures of these indicators. However, due to the fact that the surveys were administered after 10 weeks of instruction coupled with the fact that the undergraduate prior experience group did not complete the survey leaves us unable to answer this question. A subsequent study will need to be done in which all subjects complete the survey at the time the lesson plan is collected. At this point, analysis can be done to measure the degree to which survey responses support scored on the lesson plans.

The third question posed by this study asked if the instruments used were effective in identifying elements of a student-centered perspective. Initial results indicate that the rubric used in scoring lessons captures obvious indicators of a student-centered approach. However, as both groups with some prior experience had no significant differences in domain scores, we can assume that either there was no difference or the tool was not sensitive enough to pick up on subtle differences. As the number of subjects in the two groups with prior experience become more equal, we will be able to better assess the effectiveness of the rubric.

The analysis provided some pilot results: a main effect of lower scores for the pre-service teachers with no experience, and a within-subjects main effect for mean scores from some of the domains, and no significant interactions between groups and domains. In a future study with a larger sample, we will want to look more closely at whether the different domains are measuring distinct aspects of student centeredness, or whether some domains should be combined because they are measuring the same construct. The same is true for the survey instrument. As a whole, our results told us that students distinguished between the set of questions that the researchers had categorized as student-centered approaches and the set of questions that were categorized as conventional approaches. This was evidenced by a significant within-subjects main effect between the two types of questions in the survey analysis. However, in a future study, we will want to examine how individual questions are measuring distinct or the same subject conceptions within one category or the other.

The study also revealed that the students who adopted the notion of student-centered instruction as a result of undergraduate experiences retained this belief and practice even after some time (from one to three years) had passed after exposure to modeling of these teaching strategies. Because the number of pre-service students with prior experience is such a small number ($n = 5$) and is much smaller than the other two samples ($n = 25$ and $n = 17$), this finding, though, cannot be generalized. It does indicate a need for further study with a larger sample.

This study is unable to use survey data to answer the research questions, as due to unforeseen events, the survey was administered at the end of the math methods course. The instructor had given the students multiple opportunities to experience student-centered lessons as learners. This naturally skewed the results of the survey. Once the students had some knowledge of the benefits of reform-based pedagogy, they would be expected to respond to the survey with some inclination toward incorporating these strategies into their own teaching.

Future Study

Future studies will investigate the relationship of fieldwork to the adoption of student-centeredness. What is the role of the mentor teachers in the fieldwork classrooms in modeling reform-based pedagogy? How does the quality of the experiences affect pre-service teachers' beliefs about effective lesson design?

As more of the CA Teach students enter the UCI credential program, the number of pre-service teachers with prior experience will grow. When the researchers conduct a similar study next fall, the numbers of participants in each sample should be approximately the same. This will lead to more generalizability of the results.

The survey data raise the question about a possible interesting interaction effect: while both sets of pre-service teachers have adopted a similar level of inclination toward student-centered approaches and objectives as a result of their prior exposure to these ideas, at the same time, is it the case that the pre-service teachers with greater and more prolonged prior exposure are less inclined than the comparison group to say that they will adopt more traditional teacher-centered practices in their survey responses? In other words, while having some exposure to ideas about student-centered pedagogies may have a more immediate effect on individuals' disposition to recognize and say that they will adopt those practices, more prolonged exposure to those ideas may have a greater influence on changing individuals' inclination not to choose non-student-centered approaches. This can be studied as the number of Pre-service prior experience subjects increases.

Future research should also investigate the effect of fieldwork on the pre-service teachers' adoption of reform-based teaching practices. Even though, in this study, the survey tool had questions about fieldwork experience, they did not elicit enough detail in responses to determine the effect of prior fieldwork experience on pre-service teacher adoption of a student-centered perspective in lesson design. In their responses to the question of fieldwork experience, some students indicated that they had little to no experience. But on the next page they indicated that they had tutored, coached, and worked in informal settings. Even though the researchers consider these to be fieldwork experiences as well, the respondents did not. So "fieldwork" needs to be defined for future respondents so that they understand the intent of this question. In addition, students responded that they had "1 year" or "9 months" of experience but this does not give any indication to the number of hours or contacts with mentors or children. Neither is there any indication of the quality of the fieldwork experience. For future study of the effects of fieldwork, the survey tool needs to be revised to offer responses regarding the quality of interactions with mentors and children.

Though the researchers intended to sample the science methods class, the assignment given by the instructor precluded any comparison because the students were directed to write demonstrations that included student discussion and/or labs. In the future, the science methods instructor will be asked to give a similar assignment as the one given to the math methods students so that a similar comparison can be made with these students. Will science students who experienced traditional teacher-centered instruction in their university courses (as well as their education courses) have similar lesson plans to their math counterparts or will their science lessons be more student-centered because the science methods students had experienced labs in their undergraduate courses?

The researchers intend to repeat this study next fall with a revised survey administered prior to any coursework for the non-treatment group and with the science students included as described above.

With the high demand for math and science teachers coming out of university credential programs, it is important for the research community to continue to investigate the effect of quality undergraduate experiences involving fieldwork and coursework with experienced K - 12 teachers as well as modeling of reform-based teaching strategies on pre-service teacher beliefs. As the need for many of the new teachers arises in low-performing schools, it is even more essential that university graduates have the tools to be effective with this population; i.e., student-centered strategies. What are the best experiences these pre-service teachers can have and when should these quality experiences begin? These are the questions researchers continue to answer.

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Appendix A

University of California, Irvine
Department of Physical Sciences

PS 5/ BS 14
California Teach 1 (CaT1): Elementary School Science and Math Classroom Practices
Winter 2007
Fridays 3-6 PM; 1/12, 1/26, 2/2, 2/9, 2/23, 3/9
Room HICF 100K

Instructors: **Karajean Hyde & Terry Shanahan**
Email: **khyde@uci.edu tshanaha@uci.edu**
Phone: **(949)824-4808 (949)824-2253**
Office Hours: **After class or by appointment**

Units: 2 units

Catalog Description:
Freshman seminar for students interested in becoming middle or high school teachers of math or science. Meets 5 times for students to gain an understanding of effective, research-based teaching strategies. Includes an opportunity to experience teaching in a K-5 classroom. Pass/Not Pass or letter grade.

Goals and Objectives:
PS 5 introduces students to the teaching and learning of science and mathematics in elementary school classrooms and it provides students with opportunities to determine if they might be interested in pursuing a career in teaching. Pairs of students will be placed in an elementary school in a local school district and will observe and assist an elementary school mentor teacher teaching science and mathematics. Students will be expected to assist the teacher in both sciences and mathematics. The accompanying seminar course will introduce students to the theory and practice of designing and delivering excellent science and mathematics instruction at the elementary classroom level. Students will be introduced to inquiry based learning practices, national and California standards, reading and learning differences in children, and the cognitive ability of elementary students as it relates to the introduction of concepts, curricular planning, classroom management and learning assessment.

<u>**CaT1 - Course Objectives:**</u>

- Introduce the profession of teaching as a possible career path. Students will observe and engage in the professional nature of teaching, including working collaboratively with other teachers, identifying and sharing best practices, and being accountable for meeting professional standards.
- Understand how national and state standards in science and mathematics affect curricular design and how curricular design prepares students for subsequent learning.

- Critically observe both teaching and learning in science and mathematics, paying particular attention to the role of misconceptions and sense-making as students learn new information. Learn how to assess if students are learning the material.
- Recognize why a deep understanding of the science and math subject matter is essential for understanding how students learn, particularly in making sense of the rich variety of ways individuals may approach the same problem.
- Understand the difference between learner-centered and teacher-centered curricula and be able to distinguish between classroom approaches that are inquiry-based (hands-on) and those that are informational.
- Understand the diversity of learners in a classroom and evaluate teaching methods that address the variety of ways students learn and make sense of new information.
- Review and evaluate issues of teaching English language learners mathematics and science.
- Provide students the opportunities to develop inquiry-based curricular modules that they will co-present to students in the classroom. These modules should have stated educational objectives and include a means to assess whether the module met the learning objectives stated.
- Provide students with the opportunity to reflect on and discuss what they have observed.
- Introduce students to the concept that as classroom assistants or teachers, they are "role models" to students and that there are great responsibilities inherent in assuming this role. Students in this program will need to focus on how they dress, talk, respect themselves and their students, and how important these elements are in creating a respectful and inclusive classroom atmosphere where students learn most effectively. They will learn to assure that all students are adequately prepared in safety, security, and emergency procedures.
- Students will become familiar with the California Teach program, courses, teaching certification programs and requirements, financial support, and their work during the course will provide their first entry into their California Teach Portfolio that they will maintain as a requirement for teacher certification.

In addition, PS 5 provides multiple and systematic opportunities for candidates to practice competencies for CTCC Teaching Performance Expectations (TPEs):

TPE 1: Specific pedagogical skills for subject matter instruction.
TPE 2: Monitoring students learning during instruction.
TPE 3: Interpretation and use of assessments.
TPE 4: Making content accessible.
TPE 5: Student engagement.
TPE 6: Developmentally appropriate teaching practices.
TPE 7: Teaching English Learners.
TPE 8: Learning about students.
TPE 9: Instructional planning.
TPE 10: Instructional time.
TPE 13: Professional Growth.

Required Text: None

Course Assignments:

- Teaching Reflection Paper **Due 1/26/07**
- Read "Improving Instruction by Listening to Children" and complete review **Due 2/9/07**
- Draft 5 E Lesson **Due 3/2/07**
- Final Lesson Plan **Due 3/16/07**
- Lesson Reflection **Due 3/16/07**
- Final Journal **Due 3/20/07**
- PCOP **Due 3/20/07**
- Completion of 20 hours of field work **Due 3/20/07 Note: Hours must be logged into OIS to be counted. OIS training must be completed by Feb. 2.**

Grading Policy:
This course may be taken for a letter grade or as pass/no pass.

Course Grading: Each assignment will be worth the points detailed below. Note: Assignments will lose 1 point for each day it is late.

Teaching Reflection Paper- 10 points
Reading Review- 10 points
PCOP- 10 points
Lesson Plan- 25 points
Lesson Reflection- 20 points
Final Journal- 15 points
Attendance/ Participation- 50 points
20 hours of field work- 60 points

Your course grade will then be determined by the sum of your 8 scores on the following scale:

A: 180 points or higher
B: 160-179 points
C: 140-159 points
D: 120-139 points
F: 119 points or less or missing more than 1 class

Pass: 120 points or higher
No Pass: 119 points or less or missing more than 1 class

Attendance: Your on-time attendance and participation in all of our class sessions is critical to both your success and the growth of all of your classmates. There really is no "making up" a missed class day. If you do have a medical or other emergency that forces you to miss a class, however, I will work with you individually on an appropriate assignment to substitute for the lost time.

Students who miss all or significant parts of a 2nd class will need to repeat the course. Lateness will result in deductions from your score for participation.

Course Schedule:

Date	Topic	Assignment Due
1/5/07	**Orientation with Roslyn!!**	
1/12/07	Orientation to course and fieldwork; Working with elementary students; Sound (T)	**None**
1/19/07	**OIS training @ CFEP**	**TB & Fingerprints!!!**
1/26/07	**TPE 1** Content Standards; State Testing; K-5 Math (K)	**Submit:** Teaching Reflection Paper
2/2/07	**TPE's 6 and 8** Questioning; Interacting with elementary students; K-2 Math investigation; 3-5 Science activity (K/T)	**None**
2/9/07	**TPE's 3, 6, and 9** Types of knowledge (K); K-5 Science investigation (T)	**Submit**: Read "Improving Instruction by Listening to Children," complete review
2/16/07	**No Class**	**None**
2/23/07	**TPE's 1, 2, 4, 5, 6, and 9** Writing a 5 E's Lesson Plan; Math or Science vertical team	**None**
3/2/07	**No Class**	**Submit**: Draft Lesson Plan
3/9/07	**TPE's 4, 5, 7, and 10** Peer Classroom Observation Protocol; K-2 Science; 3-5 Math (T/D)	**None**
3/16/07	**No Class**	**Submit**: Final Lesson Plan & Lesson Reflection
3/20/07	**Finals Week: No Class**	**Submit**: Final Journal, PCOP & Hours Log

University of California, Irvine
Department of Physical Sciences

PS 105 -California Teach 2 (CaT2): Middle School Science and Math Classroom Practices
Winter 2007
Fridays 3-6 PM: Jan. 12, 26, Feb. 9, 23 and March 2
Room HICF 100L

Instructors: Karajean Hyde & Terry Shanahan
Email: khyde@uci.edu tshanaha@uci.edu
Phone: (949)824-4808 (949)824-2253
Office Hours: After class or by appointment

Units: 2 units

Catalog Description:
Sophomore/junior seminar for students interested in becoming middle or high school teachers of math or science. Meets 5 times for students to gain an understanding of effective, research-based teaching strategies. Includes an opportunity to experience teaching in a 6-8 classroom. Pass/No Pass or letter grade.

Goals and Objectives:
PS 105 introduces students to the teaching and learning of science and mathematics in middle school classrooms. Students will serve as a classroom assistant with an expertise in either science or mathematics, supervised in a local school by an effective middle school mentor teacher. In the seminar portion of this class, students will discuss learning in a middle school culture, cognitive development of students at this level, and the best means to teach appropriate science and mathematics concepts at this level. Working in pairs, they will develop two curricular modules and, at the discretion of the mentor teacher, present one of these to a middle school class and assess their effectiveness by measuring student learning.

CaT2 - Course Objectives:

- Recognize elements of middle school culture and how it affects teaching and learning in the classroom.
- Note how the middle school curricula in science and mathematics builds upon the concepts taught at the elementary level and how these concepts prepare students for high school science and mathematics.
- Develop a toolkit of classroom management strategies.
- Observe and discuss what middle school students' approaches to solving problems in math and science reveal about their understanding of the subject matter and make connections to their own approaches to learning science and math as undergraduates.
- Become familiar with national and state standards in science and mathematics at the middle school level and learn how to maximize the interrelatedness of curriculum, textbook adoption, standards, and assessments.
- Knowledge of state, national and international assessment testing and how this affects what is taught in classrooms.

- Develop and present a lesson using research-based pedagogies.
- Determine methods to most effectively reach a diversity of learners in a classroom.
- Discuss issues of classroom management and school rules and regulations that are the responsibility of the teacher to enforce.
- Develop their abilities to use technology to enhance teaching and learning and to excite students.
- Develop knowledge of special learners curricula and classroom approaches for students with disabilities and students who are English language learners.
- Formally, through course requirements, reflect in writing on their progress as teachers and as learners and on teaching and learning practices they are experiencing in their undergraduate classes.

In addition, PS105 provides multiple and systematic opportunities for candidates to practice competencies for CTCC Teaching Performance Expectations (TPEs):

TPE 1: Specific pedagogical skills for subject matter instruction.
TPE 2: Monitoring students learning during instruction.
TPE 3: Interpretation and use of assessments.
TPE 4: Making content accessible.
TPE 5: Student engagement.
TPE 6: Developmentally appropriate teaching practices.
TPE 7: Teaching English Learners.
TPE 8: Learning about students.
TPE 9: Instructional planning.
TPE 10: Instructional time.
TPE 11: Social Environment
TPE 13: Professional Growth.

Required Text: None

Course Assignments:
- Read “Social Class and the Hidden Curriculum of Work” and complete review **Due 1/26**
- Read “Motivating Students by Teaching for Understanding” and complete reflection **Due 2/16**
- Analysis of student work **Due 2/23**
- PCOP **Due 3/2**
- Lesson Plan- Draft **Due 3/5**
- Final Lesson Plan **Due 3/16**
- Lesson Reflection **Due 3/16**
- Final Journal **Due 3/20**
- Completion of 15 hours of field work **Due 3/20 Note: Hours must be logged into OIS to be counted. OIS training must be completed by Feb. 2.**

Grading Policy:
This course may be taken for a letter grade or as pass/no pass .

Course Grading: Each assignment will be worth the points detailed below. Note: Assignments will lose 1 point for each day they are late.

Reading Review- 10 points each
Peer Classroom Observation Protocol (PCOP)- 10 points
Lesson Plan- 20 points
Analysis of Student work- 10 points
Final Journal- 10 points
Lesson Reflection- 20 points
Attendance/ Participation- 50 points
25 hours of field work- 60 points

Your course grade will then be determined by the sum of your 9 scores on the following scale:

A: 180 points or higher
B: 160-179 points
C: 140-159 points
D: 120-139 points
F: 119 points or less or missing more than 1 class

Pass: 120 points or higher
No Pass: 119 points or less or missing more than 1 class

Attendance: Your on-time attendance and participation in all of our class sessions is critical to both your success and the growth of all of your classmates. There really is no "making up" a missed class day. If you do have a medical or other emergency that forces you to miss a class, however, I will work with you individually on an appropriate assignment to substitute for the lost time. Students who miss all or significant parts of a 2^{nd} class will need to repeat the course. Lateness will result in deductions from your score for participation.

Course Schedule:

Date	Topic	Assignment Due
Jan. 5	**No Class**	**None**
Jan. 12	**Orientation** **TPE's 1, 4, 5, 6** Content Standards; Textbooks; Teaching for Conceptual Understanding; Math games! (K)	**None**
Jan. 19	**No Class**	**None**
Jan. 26	**TPE's 4, 7, 8** Teaching Special Populations; Newton & Inertia (T)	**Submit:** Read Social Class and complete Reflection
Feb. 2	**No Class**	**None**
Feb. 9	**TPE's 3, 8, 13** Incorporating Student Error and Encouraging Student Discourse(T); Reaction Time (K)	**None**
Feb. 16	**No Class**	**Submit:** Read Motivation article and complete reflection
Feb. 23	**TPE's 6, 8, 10, 11** Middle School students & classroom management. (K) Math: Area; Science: Chemical Change K-8 (K/T)	**Submit:** Student Error Analysis
March 2	**TPE's 1, 2, 3, 6, 9, 10** Assessing Student Learning; Writing a 5 E's Lesson Plan; Math: Algebra Tiles; Science: Energy (T/K)	**Submit:** PCOP **Due MONDAY March 5:** Lesson Plan- Draft
March 9	**No Class**	**None**
March 16	**No Class**	**Submit:** Lesson Reflection & Final Lesson Plan
March 20	**Finals Week: No class meeting**	**Submit:** Final Journal & Hours Log

Appendix B

Teacher- vs. Student-Centeredness Rubric for Lesson Plan Analysis

Domain 1: The intent of the lesson

Level 1	Level 2	Level 3	Level 4
▪ Goal is for students to be able to repeat or replicate information or a procedure ▪ Students take in information.	▪ Goal is for students to know and be able to do a procedure or to explain vocabulary. ▪ Students do practice problems or solve questions from the textbook.	▪ Goal is for students to come to their own understanding of a concept or their own solution to a complex problem. ▪ Students engage in hands-on learning.	▪ Goal is for students to determine the topic of investigation and carry out their own plan to solve it. ▪ Students engage in generating questions which they subsequently find methods to solve.

Domain 2: Student interest and prior knowledge

Level 1	Level 2	Level 3	Level 4
▪ Lesson is completely based upon what the teacher decides to do; i.e., there are no connections to prior learning or real-life.	▪ Lesson has weak connection to students' prior knowledge or interests.	▪ Lesson has strong connections to students' prior knowledge or interests.	▪ Lesson evolves from both students' prior knowledge and their interests.

Domain 3: Data, Claims and Evidence

Level 1	Level 2	Level 3	Level 4
▪ Teacher collects or gives students data or information. ▪ Teacher explains why something is so. ▪ One correct solution/explanation and method/reasoning is acceptable.	▪ Students work with the teacher to collect/generate data ▪ Students respond to teacher questions to explain why something is so. ▪ While one solution and method is preferred, other methods can be shared.	▪ Students collect data. from teacher directions. ▪ Students explain what they found to their peers and the teacher assists in summarizing. ▪ Each group or individual is encouraged to express their thinking in their own way.	▪ Students decide how to collect and record data. ▪ Students are the sole ones explaining and making sense of the material. ▪ Students use multiple means to express their ideas (journals, reporting out, drawings, charts/graphs)

Domain 4: Teacher role during the lesson

Level 1	Level 2	Level 3	Level 4
▪ Lesson is all lecture. Any questions asked by the teacher deal with management issues or recall. ▪ When an error is made, the teacher corrects the student.	▪ Teacher does some lecture/explaining but questions students about facts or procedures learned in the lesson. ▪ When an error is made, the teacher points it out and explains.	▪ Teacher poses questions to develop student thinking that begin to link concepts in that lesson or between lessons. ▪ When an error is made, teacher questions student to lead him/her to discover the error or has another student explain.	▪ Teacher poses questions that connect lessons to key concepts and requires students to explain their responses with clear lines of evidence. ▪ Students catch each others' errors and question their peers to help them arrive at the correct answer.

Domain 5: Student Role and Engagement

Level 1	Level 2	Level 3	Level 4
▪ Students are passive recipients of information OR students are completely off-task.	▪ Students may answer recall/procedural questions. ▪ Students are dis-interested in lesson or use only lower-level thinking.	▪ Students are guided to use data to find patterns and generalize or draw conclusions. ▪ Students discuss findings with classmates.	▪ Students find the means to solve/understand a problem. ▪ Students are the ones who teach each other.

Domain 6: Group Size and purpose

Level 1	Level 2	Level 3	Level 4
▪ Instruction is whole class or independent practice/reading. ▪ Questions students have are directed to and answered by the teacher. ▪ There is no discussion between the class and teacher or between classmates.	▪ Instruction is whole class, but students may collaborate to work on problems or an assignment. ▪ Questions may be asked of classmates. ▪ Discussion is limited to checking answers or to management issues.	▪ Students work in groups for the majority of the class. ▪ Students pose questions to one another and only ask the teacher if no one else knows. ▪ Group members are in continual discussion with one another and, when necessary, with the teacher.	▪ Students are in groups for the entirety of the class. ▪ Students seek out classmates or other resources to have questions answered. ▪ Groups members are in constant discussion with one another as well as with other groups.

Appendix C

Views of Math and Science Teaching Survey

You have been selected to answer questions about your experience and views about secondary (grades 6-12) math or science teaching. This survey is part of a study we are conducting about the effect of prior fieldwork experience on lesson plan design by preservice teachers. Your responses will be anonymous and will only be reported as aggregate data.

<u>How to complete the questionnaire</u>

Most of the questions instruct you to circle one answer or circle all that apply. For a few questions you are asked to write your answer on the lines provided. Please answer all questions honestly or leave a question blank, if needed.

I modified question 1 and added a question to reflect that fact that we expect credential candidates to do the survey, some of whom were UCI undergraduates, some of whom were undergrads at a UC with Cal teach or CMST, and some of whom were neither.

Section A: Background and Experience

1. This question is for individuals who are/were UCI undergraduates. Which of the following seminar courses have you taken (circle all that apply).				
PS 114/ED 114	US 5/PS 5/BS 14	PS 105/ BS 101	PS 106/BS 102	None

2. This question is for individuals who were undergraduates at a University of California campus other than UCI. Please circle all of the programs in which you participated at your university..		
CTFMS	CMST	California Teach Science & Math Initiative (SMI)

3. Approximately how many hours of fieldwork have you spent in K-12 classrooms prior to starting a teacher credential program? Circle one choice.			
0-20 hours	21-60 hours	61-120 hours	More than 120 hours

4. Please list any past experience you have had that involved tutoring, teaching, or helping people to learn. This could be volunteer work, a paid job, a service project for a class or organization, or other opportunities that you had to help people learn. For each different type of experience, please write the name of the organization or program (if applicable), describe what you did, and indicate for how long you did it.

Organization	**What I did**	**Length of Time**
Example: JumpStart	Example: Tutored small children	Example: 9 months

5. How confident are you that you will become a math or science teacher within the next three years? Circle the best choice.			
Not at all confident	Somewhat confident	Confident	Absolutely sure

Section B: Views on various aspects of teaching
Please indicate your plans for implementing each of the following in your math or science instruction when you become a classroom teacher. How often do you plan to do each of the following? Please circle one answer for each statement.

1. Take students' prior understanding into account when planning curriculum and instruction.			
I seldom will do this	I will do this sometimes	I will do this often	I consistently will do this

2. Give students vocabulary words and definitions at the beginning of a unit.			
I seldom will do this	I will do this sometimes	I will do this often	I will consistently do this

3. Develop students' conceptual understanding of math or science.			
I seldom will do this	I will do this sometimes	I will do this often	I will consistently do this

4. Demonstrate algorithms followed by having students practice.			
I seldom will do this	I will do this sometimes	I will do this often	I will consistently do this

5. Lead a class of students using investigative strategies.			
I seldom will do this	I will do this sometimes	I will do this often	I will consistently do this

6. Have students work in cooperative learning groups.			
I seldom will do this	I will do this sometimes	I will do this often	I will consistently do this

7. Have students work silently.			
I seldom will do this	I will do this sometimes	I will do this often	I will consistently do this

8. Listen/ask questions as students work in order to gauge their understanding.			
I seldom will do this	I will do this sometimes	I will do this often	I will consistently do this

9. Correct and point out student errors.			
I seldom will do this	I will do this sometimes	I will do this often	I will consistently do this

10. Guide students to discover answers (rather than give them the answers).			
I seldom will do this	I will do this sometimes	I will do this often	I will consistently do this

Section C: Student Objectives

Think about your plans for teaching math or science over the course of a school year. How much emphasis will each of the following student objectives receive? Please circle one answer for each statement.

1. Increase students' interest in math or science.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

2. Understand math or science concepts.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

3. Memorize procedures and facts.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

4. Learn problem solving skills.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

5. Discover how math or science ideas connect to and relate to one another.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

6. Explain math or science ideas effectively.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

7. Perform computations with speed and accuracy.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

8. Learn test-taking strategies.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

9. Develop inquiry skills.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

10. Take accurate lecture notes.			
Little to no Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis

Section D: Teaching Strategies
About how often do you plan to do each of the following in your math or science instruction? Please circle one answer for each statement.

1. Introduce content through formal presentations.			
Seldom	Sometimes	Often	Daily

2. Pose open-ended questions.			
Seldom	Sometimes	Often	Daily

3. Engage the whole class in discussions.			
Seldom	Sometimes	Often	Daily

4. Require students to explain their reasoning or supply evidence to support their claims.			
Seldom	Sometimes	Often	Daily

5. Ask students to explain concepts to one another.			
Seldom	Sometimes	Often	Daily

6. Ask students to consider alternative methods or explanations.			
Seldom	Sometimes	Often	Daily

7. Ask students to use multiple representations or means of explanations (e.g., numbers, words, graphs, pictures).			
Seldom	Sometimes	Often	Daily

8. Allow students to work at their own pace.			
Seldom	Sometimes	Often	Daily

Section E: Your Teaching Philosophy
The following paragraphs describe observations of two teachers' classes, Ms. Hill's and Mr. Jones'. Please circle one answer for each statement for whose class best represents your philosophy.

Ms. Hill was leading her class in an animated way, asking questions that the students could answer quickly; based on the reading they had done the day before. After this review, Ms. Hill taught the class new material, again using simple questions to keep students attentive and listening to what she said.	Mr. Jones' class was also having a discussion, but many of the questions came from the students themselves. Though Mr. Jones could clarify students' questions and suggest where the students could find relevant information, he couldn't really answer most of the questions himself.

1. Which type of class discussion are you more comfortable having in class?				
Definitely Ms. Hill's	Tend towards Ms. Hill's	Can't decide	Tend towards Mr. Jones'	Definitely Mr. Jones'

2. Which type of discussion do you think most students prefer to have?				
Definitely Ms. Hill's	Tend towards Ms. Hill's	Can't decide	Tend towards Mr. Jones'	Definitely Mr. Jones'

3. From which type of class discussion do you think students gain more knowledge?.				
Definitely Ms. Hill's	Tend towards Ms. Hill's	Can't decide	Tend towards Mr. Jones'	Definitely Mr. Jones'

4. From which type of class discussion do you think students gain more useful skills?				
Definitely Ms. Hill's	Tend towards Ms. Hill's	Can't decide	Tend towards Mr. Jones'	Definitely Mr. Jones'

Section F: Student Activities
About how often in your math or science class do you expect students to take part in each of the following activities? Please circle one answer for each statement.

1. Listen and takes notes during presentation by the teacher.			
Seldom	Sometimes	Often	Daily

2. Work in groups.			
Seldom	Sometimes	Often	Daily

3. Read from a textbook in class.			
Seldom	Sometimes	Often	Daily

4. Watch the teacher perform a science demonstration or solve math problems.			
Seldom	Sometimes	Often	Daily

5. Do hands-on activities or investigations.			
Seldom	Sometimes	Often	Daily

6. Review homework or class work.			
Seldom	Sometimes	Often	Daily

7. Answer textbook or worksheet questions.			
Seldom	Sometimes	Often	Daily

8. Design and implement their own investigation.			
Seldom	Sometimes	Often	Daily

9. Write reflections (e.g., in a journal).			
Seldom	Sometimes	Often	Daily

10. Make formal presentations to the rest of the class.			
Seldom	Sometimes	Often	Daily

Section G: Free Response
Pleas use the lines provided to answer the following questions.

a) What should a teacher's role be in an effective math or science classroom?

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b) What should the students' role be in an effective math or science classroom?

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