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ABSTRACT

Science education and the preparation of science teachers have been of great concern over the past two decades. This research investigated the influence of an extended elementary science teaching practicum upon preservice elementary teachers' (N=19) science self-efficacy. It explored both quantitatively and qualitatively the progression of teacher efficacy and outcome expectancy of preservice elementary education majors as well as the influence of a science methods course before, during, or after a practicum experience. The manipulated variable in this study was the practicum experience and teaching science lessons to children on a daily basis. The qualitative parameters of this study included pre- and post-interviews, supervisor and cooperating teacher observation notes, and student journal analysis. This study found that there was a significant difference in the experience of the practicum students who had previously taken science methods as compared to the participants who had not taken science methods or who were currently enrolled in the science methods course. It was also found that the period of 10 weeks actual teaching in the classroom was a good experience for the participants involved. Contains 26 references. (Author/ASK)

# *How much is enough?*
# *Preparing elementary science teachers through science practicums*

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Science education and the preparation of science teachers have been of great concern over the past two decades (AAAS, 1993, 1989; NRC, 1996;). The professional literature clearly notes a lack of science preparation and literacy for elementary teachers being prepared by universities. (Fort, 1993; NRC, 1996; Tobias, 1992 & 1990). In an early study Weiss (1978) found that only 28% of elementary teachers felt qualified to teach science and that on the average 90 minutes per day were spent on reading instruction versus an average of 17 minutes on science instruction. These results have been corroborated by Stefanich and Kelsey (1989) who found that less time is spent on science instruction in elementary schools than any other subject. Of the time spent on science instruction, an earlier study found that 90% of the teachers relied on textbooks for about 90% of their science instruction (Stake & Easley, 1978). Yager and Lutz (1994) found similar results and further explained that science instruction was comprised of students listening to lectures, reading from textbooks, memorizing, repeating and confirming scientific facts. Although the shortcomings of teachers and teacher preparation programs are well documented, strategies of preparation related to the practice of becoming an elementary science teacher, specifically the practicum experience, has not been well documented.

Some examples of practicums have been briefly discussed in the literature. Mason (1989) explained a teaming situation of a scientist, science educator, science teacher, and a student teacher in a practicum situation. Bagheri and Hoosho (1991) explained about an integrated practicum for science and math with the accompanying benefits of combining theory and practice. Although these references deal with practicum situations, neither focus on the length of the experience. Only one citation was found that dealt with length as the primary issue of the research which was done in an elementary social studies practicum where an eight week placement was compared to a sixteen week placement (Carter, 1989). No direct literature has been found to date recording how much practicum or how little practicum is enough to produce a competent elementary science teacher. In fact, in their article entitled "The purpose, value and structure of the practicum in higher education; A literature review," Ryan, Toohey, and Hughes (1996) stated that "So little quality research has been undertaken on the effect of the length, structure and placement of the practicum that no clear recommendations can be made with confidence" (p.370)

Ryan, Toohey, and Hughes (1996) additionally state that satisfaction surveys have been the most common method for evaluation in practicum courses. They suggest that more specialized surveys be given to look at specific skills and developments gained during the practicum in addition to more longitudinal studies.

This research investigated the influence of an extended elementary science teaching practicum upon preservice elementary teachers' science self-efficacy. An "extended practicum" was defined as 12 weeks long comprising 12 hours per week placement at a LOCal elementary school where the preservice teacher was assigned to teach primarily elementary school science. Various research projects have investigated science self-efficacy beliefs from preservice through veteran teachers service. Most report very positive experiences by students in practicum experiences; however, few reports search out whether a prime time exists for enhancing science self-efficacy throughout a preservice teacher's preparation. This in-depth study explored both quantitatively and qualitatively the progression of teacher efficacy and outcome expectancy of preservice elementary education majors as well as the influence of a science methods course before, during or after a practicum experience.

## Methodology

Quantitative Design

Subjects

Subjects included 19 preservice elementary education majors (17 females, 2 males) enrolled in a practicum experience in a LOCal elementary school. The students were enrolled in a 3 semester credit *Supervised Elementary Education Practicum* course open to juniors, seniors, and graduate students during the spring 1997 semester. The practicum experience ran from 8:00 a.m. to 12:00 noon on Tuesdays, Wednesdays, and Thursdays, for 10 weeks, totaling 120 hours of pupil contact time. Although the primary responsibility of the preservice elementary students in the practicum was to teach science lessons from the adopted public school science curriculum, they also were responsible for daily management routines and any other planned content area lessons with the permission of the cooperating classroom teacher.

In addition, the practicum students were responsible for leading and presenting a science festival at the school. While science festivals resemble science fairs, this festival differed in that only whole class, or group projects were presented, no fomal judging took place, and each child received a special certificate and was recognized for some contribution to the project, ( i.e., best lettering, best construction, etc.) at a science festival assembly held at the school after the festival.

Quantitative Research Design

A form of the time-series design called an *equivalent time-samples design* was used in this study. Tuckman (1972) writes, " ... the equivalent time-samples design is used when only a single group is available for study and the group's pattern of experience with the treatment is highly predetermined -- that is, the researcher must expose the group to the treatment on some systematic basis" (p. 116). The manipulated variable, or treatment, in this study was the practicum experience and teaching children science lessons on a daily basis. The responding variables were the practicum students' scores on the Science Teaching Efficacy Beliefs Instrument (STEBI-B) by Enochs and Riggs (1990) and the Science LOCus of Control I and II (SciLOC I and II) by Haury, (1988).

Quantitative Instrumentation

The STEBI B (preservice version) (Enochs & Riggs, 1990) was administered to the preservice practicum teachers on a weekly basis. The STEBI B includes 23 Likert-scaled statements relating to personal beliefs about teaching science. Response categories are "strongly agree", "agree", "uncertain", "disagree", and "strongly disagree." The STEBI B measures two sub-scales inhering to Bandura's (1977) theory of self-efficacy and applied to teaching by Gibson and Dembo (1984). The two subscales are personal science teaching efficacy beliefs (PSTEB) and science teaching outcome expectancy(STOE). The sub-scale for PSTEB numbers 13 statements. A full account of the reliability and validity measures for STEBI B can be found in Enochs and Riggs (1990). This study resulted in a Cronbach's alpha of .83 for the PSTEB and .77 for the STOE.

Clearly, test sensitivity was a major threat to internal validity. In an attempt to lessen this threat, the SciLOC I and SciLOC II instuments were adminstered during weeks 8 and 9. The 18-item SciLOC questionnaires measure a participant's LOCus of control (LOC), or belief about the internal or external responsibility for learning, in relation to science education. Reliability measures for SciLOC I and II were established by internal consistency coefficients of 0.73 and .75 respectively (Cronbach's Alpha) (Haury, 1988). Haury (1988) states, "An assumed benefit of increased internality is increases success as a teacher" (p. 234). A positive correlation was found to exist between the SciLOC I and STEBI B questionnaires ($r = .43$; $p < .01$) supporting the speculation that both measure similar constructs (Cannon, 1992). Therefore, the SciLOC I and II instruments were deemed appropriate as additional data collection instruments for perhaps revealing an additional facet of relationship between the STEBI B and SciLOC instruments.

### Qualitative Research Design

The qualitative parameters of this study included pre and post interviews given the first and last week of practicum, supervisor and cooperating teacher observation notes (participant observations), and student journal analysis. For the qualitative part of this study 6 students were purposefully selected and studied in-depth in a multiple case study design (Merriam, 1988). For further investigation of the differences in the STEBI B quantitative analysis, two students were selected who had taken the elementary science methods course before the elementary science practicum course, two students were selected who were concurrently enrolled in the elementary science methods course and the elementary science practicum course, and two students who had not previously taken nor was concurrently enrolled in the elementary science methods course (See Table 1). This resulted in a sizeable amount of thick and rich data which helped define the statistical analyses.

**Table 1**
**Selected Participants & science methods / practicum status**

| Participant | methods / practicum status |
|---|---|
| 001 | Concurrently enrolled in science methods and practicum |
| 002 | Previously completed science methods before taking practicum |
| 003 | No previous or concurrent science methods to practicum |
| 004 | Previously completed science methods before taking practicum |
| 005 | Concurrently enrolled in science methods and practicum |
| 006 | No previous or concurrent science methods to practicum |

## Results

### Quantitative Results

Descriptive results of the STEBI B and SciLOC administrations can be found in Tables 2 and 3 . Figures 1 and 2 show the line plots of the STEBI B subscale scores. Table 4 reports the descriptive statistics of the SciLOC I & II administrations. Table 5 reveals a statistically significant difference in PSTEB scores between weeks 1 and 12.

Table 2
Descriptive statisitics of STEBI B scores for Practicum Weeks 1 - 7, and Weeks 10 - 11.

| FIELD | N | MEAN | STD | SEM | MIN | MAX | SUM |
|---|---|---|---|---|---|---|---|
| EFFWK1 | 19 | 50.89 | 6.28 | 1.44 | 40 | 62 | 967 |
| OUTWK1 | 19 | 40.11 | 5.31 | 1.22 | 32 | 50 | 762 |
| EFFWK2 | 19 | 51.84 | 6.26 | 1.44 | 40 | 64 | 985 |
| OUTWK2 | 19 | 40.89 | 4.72 | 1.08 | 34 | 50 | 777 |
| EFFWK3 | 19 | 53.53 | 5.44 | 1.25 | 42 | 65 | 1017 |
| OUTWK3 | 19 | 40.21 | 4.30 | .99 | 35 | 50 | 764 |
| EFFWK4 | 19 | 53.53 | 5.44 | 1.25 | 42 | 65 | 1017 |
| OUTWK4 | 19 | 40.21 | 4.30 | .99 | 35 | 50 | 764 |
| EFFWK5 | 19 | 57.68 | 5.16 | 1.18 | 46 | 64 | 1096 |
| OUTWK5 | 19 | 41.68 | 4.57 | 1.05 | 33 | 49 | 792 |
| EFFWK6 | 19 | 55.05 | 4.70 | 1.08 | 44 | 64 | 1046 |
| OUTWK6 | 19 | 41.58 | 4.74 | 1.09 | 35 | 50 | 790 |
| EFFWK7 | 19 | 54.84 | 4.68 | 1.07 | 46 | 63 | 1042 |
| OUTWK7 | 19 | 40.47 | 6.16 | 1.41 | 26 | 50 | 769 |
| EFFWK10 | 19 | 59.74 | 4.21 | .97 | 53 | 65 | 1135 |
| OUTWK10 | 19 | 42.11 | 4.62 | 1.06 | 34 | 50 | 800 |
| EFFWK11 | 19 | 59.89 | 4.07 | .93 | 52 | 65 | 1138 |
| OUTWK11 | 19 | 42.21 | 5.74 | 1.32 | 33 | 50 | 802 |

eff = Personal Science Teaching Efficacy Beliefs Scores (PSTEB)
out = Science Teaching Outcome Expectancy Scores (STOE)

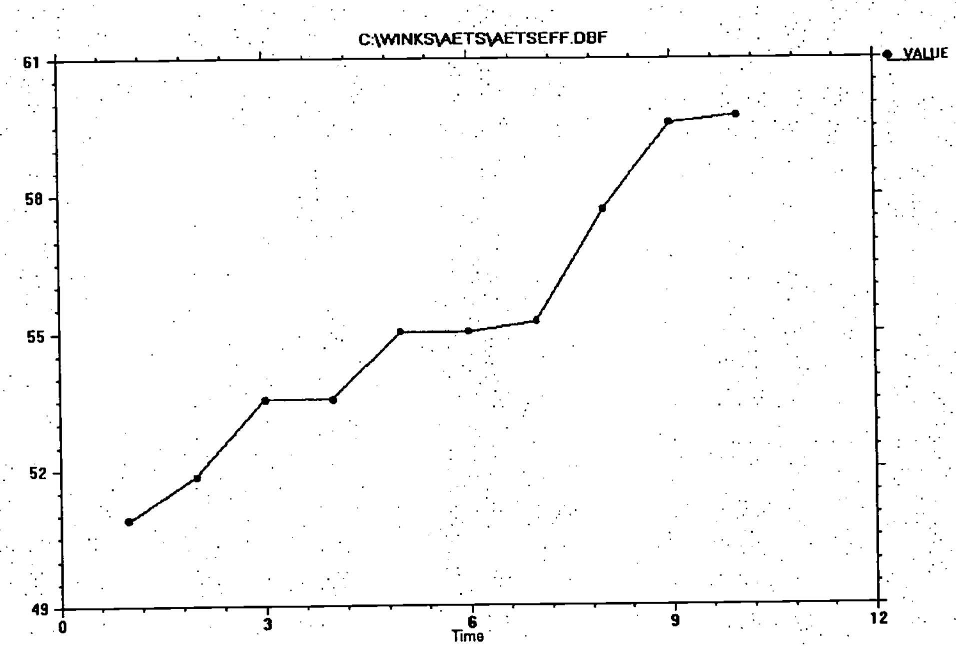


Figure 1. Line plot of Personal Science Teaching Efficacy Beliefs Scores (PST EB) scores for weeks 1 - 7, and 10 - 11.

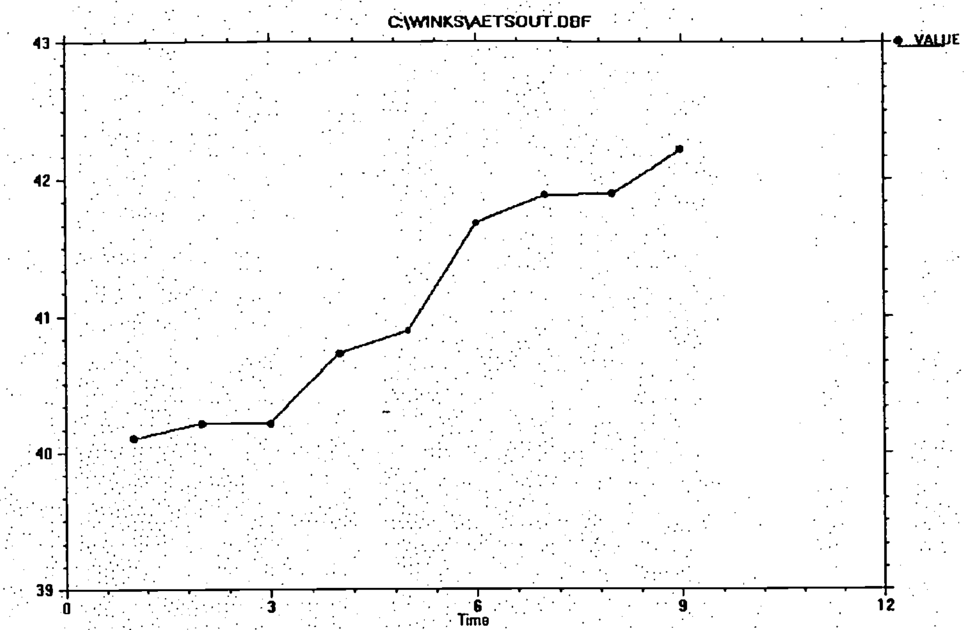


Figure 2. Figure 1. Line plot of Science Teaching Outcome Expectancy Scores (STOE) scores for weeks 1 - 7, and 10 - 12.

Table 3
Descriptive statisitics of SciLOC I and II scores for practicum weeks 8 & 9

| FIELD | N | MEAN | STD | SEM | MIN | MAX | SUM |
|---|---|---|---|---|---|---|---|
| Week 8 - LOC | 19 | 25.632 | 2.608 | .598 | 21 | 31 | 487 |
| Week 9 LOC2D | 19 | 49.000 | 3.697 | .848 | 44 | 57 | 931 |

Table 4
Wilcoxon's signed rank test results between PSTEB scores from week 1 vs. week 12

Sum of the positive ranks = 0.
Sum of the negative ranks = 190.
Number of samples = 19

Using Wilcoxon table lookup, $p <= 0.005$ (one tail)

Table 5
Wilcoxon's signed rank test results between STOE scores from week 1 vs. week 12

Sum of the positive ranks = 32.5
Sum of the negative ranks = 103.5
Number of samples = 16

Using Wilcoxon table lookup, $p = .037$ (one-tailed)

Qualitative Analysis

Self-efficacy

Quantitative analyses from the STEBI B show that there is a significant improvement over the course of study in self- efficacy, but the outcome expectancy, although positive, gained only 2 points for all 19 participants. This is a common pattern found in STEBI research. In order to find out more about why this pattern emerges, six questions from the STEBI B (question numbers 5, 12, and 22 for self- efficacy and question numbers 1, 9, and 16 for outcome expectancy) were used in addition to two other questions, "What does the word science mean to you" and "What anxieties do you have pertaining to the teaching of elementary science" in a pre / post interview format for six purposefully selected participants (See Table 1). Some very interesting conversations emerged which help to explain the quantitative results of the STEBI B and also the elementary science practicum and the relationship of a science methods experience.

Bandura (1981) showed that people's beliefs in their own abilities had an effect on their performance. He found that behaviors occur when, a) people believe in their own ability to perform that behavior and b) people expect, based upon their own life experiences, that this behavior will result in a desirable outcome. The first belief, that people believe in their own ability, Bandura called self-efficacy (Schoon & Boone, 1996). The second belief is closely connected to the confidence that one develops based upon their efficacy and is referred to as outcome expectancy.

The six participants all had different levels of self-efficacy, especially in the pre interviews, but by the end of the semester all of the participants believed in their ability to perform and that this ability would have desirable outcomes.

More specifically, the first question asked in order to try to understand this efficacy gain was question number 5 from the STEBI B (Enochs & Riggs, 1990). Question five states "I know the steps necessary to teach science concepts effectively." The participants that had not taken science methods and were not concurrently enrolled in science methods (participants 003 & 006) both had major reservations in the pre interview. Participant 003 stated, "right now, I know a little about the steps, but I have TONS of room for improvement." Participant 006 stated, "I don't know how science is taught in the school - I will need to see it."

Participants 001 & 005, who were concurrently enrolled in science methods, also had reservations in the pre interview. Participant 001 stated, "I'm in the process of learning the steps." Participant 005 stated, "right now I don't feel very confident in knowing the steps to teach science." Both of these participants made reference to the methods class and that between both classes they would know the steps by the end of the semester.

Participants 002 & 004, who had previously taken science methods prior to the practicum experience, felt a little more confident about the steps to teaching science in the pre interview. Participant 002 stated, "I feel more confident because of my methods class, but in reality, you can read a book and study it all you want, but until you actually get out and do it - it never really sinks in." Participant 004 stated, "It depends on the concept - some I feel prepared to teach and others I will need to research." The statement by the second participant here was supported by her journal that in the beginning she still had a lot of anxiety about the science content that she was supposed to teach and thus was missing the point about the process or steps in teaching science.

The science methods course under study taught the 5 E model of the learning cycle as outlined by Biological Sciences Curriculum Study (BSCS) (Bybee, 1990). Students go through various exercises in writing lesson plans and teaching lessons using the model. Because this methods course is held primarily on campus, the majority of these lessons are peer taught, but the planning process is basically the same for both the methods instruction and the practicum. In the first week of the practicum, one full day was spent on the 5 E model and how to develop lessons in that format. At the end of the practicum all of the participants strongly agreed with the statement of knowing the steps to teach science effectively, but a qualitative difference occurred.

Participants 003 and 006, who had not taken science methods or who weren't concurrently enrolled in methods, could not recite the steps of teaching science, or more specifically the 5 E's, when pushed in the post interview. Participant 003 stated. "Yes, I think I know the steps - I have a basic knowledge of how to teach science, but I could learn more." When pushed for the steps 003 said, "Motivation is important and using a hands-on approach." Participant 006 said, "I think that I have learned to write a lesson plan." When she was pushed for the steps she stated, "I think I know the steps - first you engage them and then you bring closure to the lesson." Participant 006 was on the right track, but information from her journal and through observations further clarified that she really did not know or use a consistent planning model for science instruction.

The participants that were concurrently enrolled in the methods course also could not list the 5 E's when pushed; however, they were able to tell the steps of lesson planning using different terms in the post interview. Participant 005 stated, "Compared from the beginning to now - I didn't know the steps, but now as I have been teaching science I now have confidence and I know the steps." When 005 was pushed for the steps she gave the scientific method and intertwined her words of the 5 E's. Participant 001 said "I know the steps, but I am still working on them - the first 5 weeks weren't as good as the last 5 weeks. I learned to plan and how to execute the plan." When 001 was pushed for the 5 E's she gave a narrative version, "Get the kids excited and interested, bring in previous knowledge, let them do the activity, regroup, then fill in the gaps."

The participants who had previously taken science methods were both able to explain the steps to teaching science effectively and were able to recite the 5 E's from memory in the post interview. Participant 002 responded, "Yes I know the steps and it is so more ingrained now - especially the engagement and how important that is." Participant 002 recited the 5 E's perfectly when asked. Participant 004 also knew the steps. She stated, "I think I do - after the methods and now the practicum I feel more confident than I ever have." When pushed for the steps she said, "you mean the 5 E's" then she recited them with explanation for each of the stages of planning.

Overall, the difference in knowing the steps to teach science effectively came in understanding the lesson design. Each participant felt that he/she could teach the lessons, but in practice the more experience they had had prior to the practicum in lesson design, methodologies, philosophies, and steps in planning hands-on type lessons seemed pertinent to both the teaching success of the practicum students and their ability to communicate those steps in the interview.

Similar patterns emerged in the narrative and interviews of the participants in question 12 from the STEBI B, "I understand science concepts well enough to be effective in teaching elementary science" and question #22, "When teaching science, I will usually welcome student questions."

Generally speaking for self- efficacy, we found for these six participants that taking the science methods course before having the practicum proved beneficial for the students and enabled them to communicate their efficacy gain better. The participants who did not have the methods or who were concurrently enrolled said to have gained in self- efficacy, but could not communicate that in the interviews. This is significant in that many students respond on tests with what they think is correct or what they would want to do "ideally" in teaching. Having the students communicate in an interview situation really clarified what the students believed to be their gain in self-efficacy. Interestingly, this was similar for those with the same amount of preparation, but for those without the science methods course it was completely different -- even though the scores were similar on the STEBI B instrument. The interview was also a way to blow away the smoke from the less prepared students and gain insight to what they thought was a gain in self- efficacy which to a small degree was for them, but not in comparison to the students with more preparation in methodology.

Outcome expectancy

In terms of teaching, outcome expectancy is defined as "a teacher's belief that student learning can be influenced by effective teaching" (Ramey- Gassert, 1990). Outcome expectancies as measured by the STEBI have some interesting results. Ramey-Gassert (1990) reported that, "Behavior is enacted when people not only expect certain behaviors to produce desirable outcomes [outcome expectancy], but they also believe in their own ability to perform the behaviors [self-efficacy]." Bandura (1977) speculated that people with a high sense of self-efficacy and outcome expectancy would act in a confident, determined manner. A mixture of the two behaviors might cause individuals to momentarily increase their labors, but in the end, this increase will lead to frustration. However, the outcome expectancy began and ended with only a two-point gain, which showed significance for this 12-week period for all 19 participants.

This result was anticipated based upon prior research on both practicing teachers and preservice teachers done by the authors. In order to understand more about outcome expectancies of preservice teachers, the effect of the duration of the practicum, and the amount of prior preparation via the science methods course, questions 1, 9, and 16 from the STEBI B (Enochs & Riggs, 1990) were used in a pre / post interview format with the six participants selected for the qualitative portion of this study (See Table 1).

Question 9 from the STEBI B (Enochs & Riggs, 1990) states, "The inadequacy of a student's science background can be overcome by good teaching." We asked the participants how they felt about this question and then pushed them for explanation of what good teaching meant to them.

Participants 003 & 006, the students who had not had science methods nor were they concurrently enrolled in science methods, had some interesting comments in the pre interview. Participant 003 stated, "I strongly agree -- science is not a big thing for most families and good teaching, whatever way, makes the students learn the most." Participant 003, in the pre interview, defined good teaching as "Whatever way makes the students learn the most." Participant 006 responded similarly in the pre interview, "I agree. I think it is important that the teacher does a good job trying to explain things to the kids. If a kid does well it is because the teacher explained it well." Participant 006 defined good teaching as "having each student succeed."

The participants who were concurrently enrolled in the science methods course also responded similarly to the non-methods participants in the pre interview. Participant 001 stated, "Yea, I agree - I mean you know where your kids are and what they are learning - so... I mean if a kid doesn't know what an atom is you can't go on and explain the positive and negative charges - this goes for all subjects." Participant 001 defined good teaching in the pre interview as the amount of knowledge (content) that the teacher posses. Participant 005 responded in the pre interview to the question as, "Yes, I agree 100%. Because there is always a time when a teacher teaches something that is not appropriate (to the level) of the students and she knows it. . . . you can then adjust and go from there." Participant 005 defined good teaching as, "planning ahead - a lot of planning ahead and making lesson plans." Both Participants really didn't address the question of the inadequacy of a students background, but rather focused on the teaching aspect.

The participants who had previously taken the methods course responded with more depth than the previous four participants in the pre interview. Participant 002 responded, "If the teachers are not teaching science then the students are not doing science and have no thoughts towards it. If a teacher teaches hands-on science the kids will see how much fun it is and then get into it and talk about it more." Participant 002 defined good teaching as "doing your homework outside of class (planning), researching and then doing ongoing evaluations of your own teaching." Participant 004, in the pre interview, stated, "I think that is true, if a child feels inadequate and the teacher can show the child that he can do it - then the child will feel much better about that." Participant 002 defined good teaching as, "A hands-on approach - kids really respond to that."

The interesting aspect of the comments in the pre interview was in the depth of the responses and in the participants who had the science methods courses reflecting the hands-on approach. Although the outcome expectancy scores were similar in numeric value from the STEBI B analysis, the qualitative analyses reveal the subtle differences at the beginning of the semester. At the end of the semester, the participants all had the same amount of time in the classroom, one would expect that the outcome expectancies might change. Although the quantitative results were minimal, there were more noticeable differences qualitatively from pre to post in all of the participants.

The participants who had not taken science methods, or who were not concurrently enrolled in methods, responded in the post interview with more depth than they did in the pre interview. Participant 003 stated, "I agree. You can overcome kids problems by being a good teacher." It may be important to note that 003 concurrently was employed in a school for drop out high school students during this practicum. He wrote in his journal often about how many kids left school because of poor teaching. Participant 003 defined good teaching at the end of the semester as, "whatever it takes to get the kids interested. There is no formula - just whatever you can do within your own power to make the kids more excited and willing to learn." Participant 006 didn't change much from the beginning of the semester with her definition. She stated in the post interview that, "I think good teaching is important because just reading out of the book they don't understand it, but if you know how to teach it the correct way (hands-on) - they get more out of it." Participant 006 defined good teaching at the end of the semester as, "Teaching to where the kids understand the concepts."

The participants who were concurrently enrolled in the science methods course also responded with more depth at the end of the practicum experience. Participant 001 stated, "I agree to a point. It is hard when there are people in your class on different levels . . . although the kids learned a lot compared from the beginning to the end." Participant 001 was placed in a classroom that had three main streamed special education students, one of which was severely handicapped and learning disabled, the other two classified as very attention deficit (ADD). Participant 001 defined good teaching at the end of the experience as, "Extra effort - working as long as necessary until the student either looses interest or until the concept is learned. This may include going back and researching a new way to teach it and explain things." Participant 005 responded at the end of the practicum and stated, "I strongly agree because good teaching is followed by good learning. Good clear explanations and observing while they are learning - you can know if they have learned." Participant 005 defined good teaching as, "Every student can learn - planning lessons to accommodate all learners."

The participants who had previously taken methods also were able to add more rich explanations to their prior comments concerning the question, "inadequacy of students background can be overcome by good teaching." Participant 002 stated, "Definitely, the inadequacy in any child is that they haven't been involved to their developmental level or been engaged in work which is fun. Kids turn off to reading and answering the questions in any subject." Participant 002 defined good teaching at the end of the practicum experience as, "Getting the kids involved - it is doing engagements which capture their attention, it is fun, it is getting kids to work on projects in groups. Get them involved in their learning. I had kids crawling up on their desks making observations (of plants growing on their desks in 2 liter pop bottles) and just talking about that stuff to each other - what other subject could allow them to do that?" Participant 004 responded to the question as, "Yes, I think that the inadequacy of any child's background can be overcome by good teaching if the teacher can get the child interested and wanting to learn." Participant 004 defined good teaching at the end of the practicum experience as, "Someone who can make a child understand without standing in front of the class and lecturing. Be able to get down with the child one on one and then evaluate their own teaching and how the kids learned. To know what went right and what went wrong in a lesson - all of that is good teaching."

It is very interesting to note that after the practicum experience all of the participants explained good teaching as involving the children in their learning. They found that active involvement and hands-on approaches worked much better than more traditional lecture and reading approaches. Also it is interesting to note the level of dialogue that occurred in the post interviews. Although there was no major changes in the STEBI B data, all participants were able to communicate their outcome expectancies much better after the experience, based upon events they encountered during the practicum and in their teaching. They now understood why they responded the way that they did rather than just making an unsubstantiated statement.

Did their outcome expectancies then really improve over the semester? Quantitatively minimally, but qualitatively more so. The students now had experiences by which they were able to substantiate their outcome expectancy responses and beliefs. The responses from the other interview questions followed a very similar pattern as the one narrated above. The narratives became richer and the participants based their responses upon their experiences. The participants' conclusions tended to align with research saying that good teaching can impact student learning. Gibson and Dembo (1984) concluded from their studies on teacher beliefs that "student learning can be influenced by effective teaching." Gibson and Dembo (1984) further concluded that teachers who also have confidence in their own teaching abilities (self-efficacy beliefs) should persist longer, provide a greater academic focus in the classroom, and exhibit different types of feedback than teachers who have lower expectations concerning their ability to influence student learning" (p. 37).

In response to the anxieties about teaching science, all of the participants had high anxiety in the pre interview. Responses ranged from "oh yea" to "I have taught kids before, but I am still just as nervous as I was the first time." By the end of the practicum all of the students were very confident in their ability to teach elementary science. All of the participants felt that the time in the classroom was just right and that very few improvements be made on the course.

The qualitative data doesn't really address the ideal time of the practicum, as these students have only had this one experience. However, the comments from the participants strongly support that the time in the classroom was just right. In an exit interview with all (19) of the students, no one said that the time was too long and the only response of the time being too short was a participant that really liked working with the kids and would miss them.

## Discussion

We believe that a sign of valuable research is when more questions are raised from a project than were originally asked. This research study did exactly that.

Based upon the review of self-efficacy research, one could safely predict that an extended practicum experience would positively influence PSTEB scores more so than a shorter practicum experience. Many have suggested that "experience *is* the best teacher." What is interesting about this prediction is determining when, if ever, a point of diminishing return exists in field work or practica experiences.

What is the most ideal amount of practica experiences? The results of this study reveal that during an 12 week practicum experience, PSTEB scores continued to raise, except for weeks 5 -7, where the scores remained fairly constant. Approximately the same increase in PSTEB scores occurred during the first 4 weeks as occurred during the last 4 weeks of the study (9 points in total). While it is only speculation, the later increase in scores might be a result of the science festival presentations held at the elementary school just after mid-term of the semester. Students could have experienced enhanced self-efficacy through an additional, somewhat more exciting, science teaching experience (science festival) in conjunction with their daily classroom experiences.

But, yet another very important question arises. If the question raised above is reversed, could one argue for *less time* to be spent in elementary science teaching practicum experiences? It appears that 9 out of 65 total PSTEB points are gained toward "ideal" science teaching efficacy by increasing supervised practicum experience pupil contact teaching time to 120 hours. Does this result support the call for increased practicum experiences and time spent supervising such experiences by already overburdened university content area specialists? Perhaps, but we strongly suggests that "a point of diminishing return" someday will be determined through an expanded research agenda relating to science self-efficacy and practica experiences.

## Conclusion

Westerback and Long (1990) investigated the impact of self-confidence and anxiety on science attitudes and science teaching. They stated, "curriculum advances have little chance of success unless the background, comfort, and approach of these [elementary] teachers can be altered and upgraded" (p. 362).

Through practicum experiences, prospective teachers get the opportunity to interact and "practice" teaching. This study found that there was a significant difference in the experience of the practicum students who had previously taken science methods as compared to the participants who had not taken science methods or who were concurrently enrolled in the science methods course. Additionally, this study found that the time of 10 weeks actually teaching in the classroom was a good experience for the participants involved. Over the course of the practicum there were significant gains in self- efficacy both quantitatively and qualitatively and although there were minimal gains quantitatively on outcome expectancy, there was sufficient evidence to support a qualitative difference amongst the participants from week 1 to week 12.

There are some great limitations to this study. Repeating the same instrument on a weekly basis results in the loss of some of the integrity of the instrument. The interviews helped to clarify the answers from the STEBI B and the practicum experience, but the interviewer was a professor that most of the students had taken courses from before and liked. That could cause some interview bias. And finally, there was no real measure to compare the time frame of the practicum experience to other practicums of other lengths.

For further study, we are changing the practicum to only three hours one day a week instead of the 12 hours (4 hours 3 days a week) that this study explored. This is based upon the research by Cannon (1997) where a minimal statistical difference in self-efficacy was found from a 150 hour practicum experience and a 3 hour practicum experience during a semester. Although there is no substitute for experience, the quest for the ideal practicum time still remains. And although Cannon's (1997) research states that there is minimal statistical difference in his study, the qualitative results from this study encourage the researchers that perhaps there is a qualitative difference and that it is worthy of spending valuable research time exploring.

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