EXTERNAL EVALUATION OF THE PROGRESSIVE SCIENCE INITIATIVE

NEW JERSEY CENTER FOR TEACHING AND LEARNING

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I. Introduction

Program History

In the summer of 2009, 42 teachers from 21 middle and high schools in three New Jersey districts – Jersey City, Newark and Patterson, as well as the Paramus campus of the Bergen County Technical Schools – arrived at Bergen County Technical High School in Teterboro for an orientation meeting that would mark the beginning of a new and rather arduous journey for them. They were about to participate in a unique and challenging program – the Progressive Science Initiative (PSI) – that would initially lead to a state physics teaching endorsement and, for some, eventual graduate degrees. The intent of the program, then and currently, was and is to dramatically increase the number and quality of physics, chemistry and biology teachers in the state, where there existed a dearth of all three.

The initial evaluation report on the program was submitted by ***Nyre and Associates. LLC™*** in August of 2010. Among its findings and conclusions was the following:

> *What has been depicted in this initial evaluation report on the PSI program is a high-quality effort that was created by and for teachers, and was administratively responsive to and delivered a rigorous, high-quality and effective training to the teachers involved. This introductory offering of the program experienced excellent retention, in spite of the fact that 35 of the 42 teachers involved did not have backgrounds in physics. In fact several of them did not have substantive backgrounds in any science area or mathematics.*

The first evaluation also included site visits to the PSI teachers' schools to observe their classrooms and speak with administrators and other teachers, and it was found that:

> *In spite of all the physical supports and accoutrements available to the PSI teachers – the SMART boards,[1] student responders,[2] shared round tables for small groups of students instead of individual desks, the same instructional notebook that was used during their own training, extant quizzes and tests reflecting the curriculum, and a generous amount of supplies for laboratory exercises and demonstrations – individual teaching methods were much in evidence in their classrooms.*

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1 SMART Boards are presentation tools that teachers can connect to a computer in the classroom. The images from the computer will be displayed on the board by a digital projector. SMART Boards allow teachers to use interactive applications with their students. Teachers can make notes on the SMART Boards, highlight content, click through to various applications and also print out content to hand to the students.

2 For those unfamiliar with student responders, they and the SMART Boards help teachers gauge when to move on, which concepts need more work and which students need help. Students enter responses to a question on the SMART Board using handheld computer devices, and a pie chart appears on the SMART Board showing the distribution of responses. This cues the instructor regarding the extent to which the students understand the current concept, which students might not, and what misconceptions of the concept might have led to incorrect answers.

Program Overview

Following that highly propitious beginning, which resulted in the placement of PSI-trained teachers in physics classrooms in the participating districts, PSI implemented its next phase of development – a second cohort of physics teacher-learners and a new cohort of current teachers wishing to become chemistry instructors.[3]

The program is administered by the New Jersey Center for Teaching and Learning, with courses being taught by specially trained Kean University professors, and the teachers receive graduate credit from Kean. The coursework includes an intensive, five-week summer session, augmented by additional coursework throughout the academic year.[4] Participating teachers' classrooms are equipped with SMART Board™ technologies, including an interactive whiteboard to demonstrate concepts and more fully engage students in the learning process, and the student responders referenced above (more commonly referred to as "clickers") are used to facilitate formative assessment of learning on both topic-by-topic and general concept levels.

Evaluation Purpose and Approach

The purpose of this year's evaluation was twofold:

1. To continue to monitor the physics program, as the curriculum, assessment methods, and laboratory and other procedures continue to evolve through the recurrent inputs and exchanges of a virtual professional learning community comprised of NJCTL staff, Kean professors, and the PSI teachers; and
2. To begin concurrent monitoring of and comparisons with the nascent chemistry program.

The evaluation approach included a survey of teachers participating in both the physics and chemistry programs in the summer of 2011, supplemented by nine focus groups containing five to eight participants each.[5] The purpose of the focus groups was to expand upon certain survey responses through a structured discussion in order to clarify ambiguities, expand upon certain topics, and to identify and explore other issues of special interest to the participants.

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[3] Some teachers enrolling in the PSI physics and chemistry programs were already teaching those subjects, but wished to add additional curricular approaches and skills to their current repertoires.

[4] The full PSI credentialing program (as opposed to its professional development programs) is focused on preparing current teachers, many of whom are teaching in fields other than physics, chemistry and/or biology, to obtain certification in these fields. The intention that these courses be taught in that sequence in the schools, rather than in the inverse order that is currently the standard in most districts in the country.

[5] All data presented throughout this report are based upon responses from and conversation with those who participated in both the survey administration and focus group activities. This included virtually everyone, except for a very small number who were absent during the three days during which these particular evaluation tasks were implemented.

II. Profile of Survey Respondents

Teacher Backgrounds and Demographics

Nearly two-thirds of the teachers enrolled in PSI courses during the summer of 2011 were participating in the physics program (33, or 64.7%), whereas slightly more than one-third (18, or 35.3%) were enrolled in the chemistry sequence (Table 1). All of the teachers taking the chemistry sequence were high school teachers, while nearly four out of five (44, or 78.8%) of the physics teachers were teaching at that level (Table 2).[6]

Table 1. *Number and percentage of PSI participants surveyed by the training program in which they were currently involved.*

Program Field	Number	Percent
Chemistry	18	35.3%
Physics	33	64.7%
Total	51	100.0%

Table 2. *Number and percentage of PSI participants surveyed by the training program in which they were currently involved and by grade levels taught.*

Grade Level	Number Chemistry	Percent Chemistry	Number Physics	Percent Physics	Number Total	Percent Total
High School	18	100.0%	26	78.8%	44	86.3%
Middle School	0	0.0%	7	21.2%	7	13.7%
Totals	18	100.0%	33	100.0%	51	100.0%

As shown in Table 3, the Newark, Paterson, and Jersey City districts contributed nearly 90 percent of the total participants (88.3%), with 33.3 percent for Newark and 27.5 percent each for Paterson and Jersey City. The Bergen County and Bergenfield districts each had two teachers in the program, and the Hillside and Orange districts each had one.

Most of the teachers were already teaching in some STEM (science, technology, engineering and mathematics) field prior to entering the program. Table 4 shows that nearly 90 percent of both the chemistry and physics participants were in this category (88.9% and 87.9%, respectively). Only two chemistry and two physics program participants were from non-STEM fields.

[6] Chemistry is rarely taught at the middle school level.

Table 3. *Number and percentage of PSI participants surveyed by the training program in which they were currently involved by district.*

District	Number Chemistry	Percent Chemistry	Number Physics	Percent Physics	Number Total	Percent Total
Newark	4	22.2%	13	39.4%	17	33.3%
Paterson	5	27.8%	9	27.3%	14	27.5%
Jersey City	8	44.4%	6	18.2%	14	27.5%
Bergen County	1	5.6%	1	3.0%	2	3.9%
Bergenfield	0	0.0%	2	6.1%	2	3.9%
Hillside	0	0.0%	1	3.0%	1	2.0%
Orange	0	0.0%	1	3.0%	1	2.0%
Totals	18	100.0%	33	100.0%	51	100.0%

Table 4. *Number and percentage of PSI participants surveyed by the training program in which they were currently involved by general fields in which they were teaching* **prior to** *their PSI involvement.*

Teaching Field Prior to PSI	Number Chemistry	Percent Chemistry	Number Physics	Percent Physics	Number Total	Percent Total
Teaching STEM	16	88.9%	29	87.9%	45	88.2%
Not Teaching STEM	2	11.1%	2	6.1%	4	7.8%
Totals	18	100.0%	33	100.0%	51	100.0%

Table 5 shows that more than four out of five (83.3%) of the teachers enrolled in the final sessions of the chemistry sequence were already teaching PSI chemistry in their schools. Even a larger proportion of those in the concluding segment of the physics sequence were teaching PSI physics (93.9%).

Table 5. *Number and percentage of PSI participants surveyed by the training program in which they were involved by the subject they began teaching after their PSI coursework.*

Subject Currently Teaching	Number Chemistry	Percent Chemistry	Number Physics	Percent Physics	Number Total	Percent Total
PSI Chemistry	15	83.3%	0	0.0%	15	29.4%
PSI Physics	0	0.0%	31	93.9%	31	60.8%
PSI Chemistry *and* Physics	1	5.6%	0	0.0%	1	2.0%
Other STEM	0	0.0%	1	3.0%	1	2.0%
Non-STEM	2	11.1%	1	3.0%	3	5.9%
Totals	18	100.0%	33	100.0%	51	100.0%

In Table 6, one can see that nearly one-third of the participating teachers held master's degrees (33.3% chemistry; 31.5% physics). The remainder held baccalaureate degrees, except for one in each group with a doctorate.

Table 6. *Number and percentage of PSI participants surveyed by the training program in which they were currently involved by highest degree attainment.*

Highest Degree Attained	Number Chemistry	Percent Chemistry	Number Physics	Percent Physics	Number Total	Percent Total
Baccalaureate	11	61.1%	21	64.50%	32	63.80%
Master's	6	33.3%	10	31.50%	16	32.50%
Doctorate	1	5.6%	1	4.00%	2	3.70%
Totals	18	100.0%	33	100.00%	51	100.00%

Nearly 80 percent of the total number of participating teachers (78.4%) had received their highest degree in a STEM field, although the proportion was much higher for the chemistry cohort (88.9%) than for the physics cohort (72.7%), as shown in Table 7.

Table 7. *Number and percentage of PSI participants surveyed by the training program in which they were currently involved by highest degree attainment and by whether that degree was in a STEM or non-STEM field.*

Highest Degree Field	Number Chemistry	Percent Chemistry	Number Physics	Percent Physics	Number Total	Percent Total
STEM Field	16	88.9%	24	72.7%	40	78.4%
Non-STEM Field	2	11.1%	6	18.2%	8	15.7%
Totals	18	100.0%	33	100.0%	51	100.0%

Approximately three-fourths of the participants held teaching certificates in a STEM field prior to entering the PSI program. (See Table 8: 77.8% chemistry; 78.8% physics).

Table 8. *Number and percentage of PSI participants surveyed by the training program in which they were currently involved by teaching certificates prior to program entry.*

Field of Certification	Number Chemistry	Percent Chemistry	Number Physics	Percent Physics	Number Total	Percent Total
STEM Field	14	77.8%	26	78.8%	40	78.4%
Non-STEM Field	3	16.7%	4	12.1%	7	13.7%
Provisional	1	5.6%	1	3.0%	2	3.9%
Totals	18	100.0%	33	100.0%	51	100.0%

Table 9 reflects the fact that teachers with six to ten years of teaching experience were equally represented in the PSI chemistry and physics programs, accounting for one-third of the participants in each group. However, the chemistry registrants included a much greater proportion of more teachers with 11-15 years of service (33.4%), compared to only 6.1 percent for the physics registrants. Conversely, the physics cohort counted more than one-fifth of its membership (21.2%) with 16 years or more of teaching experience, with the chemistry cohort having only one teacher (5.6%) in that category.

Table 9. *Number and percentage of PSI participants surveyed by the training program in which they were currently involved by years of teaching experience.*

Number of Years	Number Chemistry	Percent Chemistry	Number Physics	Percent Physics	Number Total	Percent Total
1 year or less	1	5.6%	1	3.0%	2	3.9%
2-5 years	5	27.8%	12	36.4%	17	33.3%
6-10 years	6	33.3%	11	33.3%	17	33.3%
11-15 years	5	27.8%	2	6.1%	7	13.7%
16+ years	1	5.6%	7	21.2%	8	15.7%
Totals	18	100.0%	33	100.0%	51	100.0%

A comparison of years of teaching experience between those teachers who were in the initial PSI program in 2009-2010 and those who were in the physics and chemistry programs in 2010-2011 is presented in Table 10. Fifty percent of those in the initial program had five years or less of teaching experience, whereas just under two-fifths (37.2%) were in that experience category among the 2010-2011 participants.

Table 10. *Comparison of years of teaching experience between the 2009-2010 teachers and the 2010-2011 teachers completing the PSI program.**

	2009-2010		2010-2011	
Number of Years	Number	Percent	Number	Percent
1 year or less	6	14.3%	2	3.9%
2-5 years	15	35.7%	17	33.3%
6-10 years	12	28.6%	17	33.3%
11-15 years	2	4.7%	7	13.7%
16+ years	7	16.7%	8	15.8%
Totals	42	100%	51	100.0%

* The 20009-2010 PSI program only included those teachers working toward a physics teaching certification, whereas the 2010-2011 PSI program included both those who wished to receive physics certifications and those who were pursuing chemistry teaching certifications.

III. Findings

Overview

In this section of the report, four primary tables are presented, reflecting the teachers' responses to a series of statements in three broad categories:

- **Table 11** focuses on the teachers' reported perceptions of aspects of the PSI courses – e.g., the goals, the materials, the assignments, the activities, and the technology used.
- **Table 12** focuses on the extent to which the teachers believe the PSI program has impacted their satisfaction with teaching in general, and chemistry/physics in particular, as well as the extent to which it has prepared them to:
  - Teach chemistry/physics,
  - Use and value the SMART technologies, and
  - Affect student behavior and performance.
- **Table 13** provides teachers' comparative responses regarding their attitudes and beliefs about the PSI approach and its accoutrements (i.e., SMART technologies) before and after completing the PSI program.
- **Table 14** offers a comparison of responses regarding teachers' attitudes and beliefs concerning teaching and learning science both before and after completing the PSI program, as well as their confidence levels regarding understanding science in general and chemistry/physics in particular.

The findings for each item in each of these tables were subsequently subjected to tests of statistical significance[7] to determine the extent to which differences between any of the following comparison groups on any items were of consequence:[8]

- Participation in the chemistry versus physics PSI program area;
- Having a degree in a STEM versus non-STEM field;
- The level of degree held (i.e., baccalaureate vs. master's); and
- Years of teaching experience.

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[7] A test of statistical significance – in this instance, a non-parametric chi square analysis – determines the degree of confidence one can have in accepting or rejecting a hypothesis. Typically, the chi square analysis used determines whether or not two different samples (of people, test scores, etc.) are different enough in some characteristic or aspect of their behavior that one can generalize that the populations from which our samples are drawn are also different in the behavior or characteristic.

[8] A .05 (5%) significance level is a generally accepted norm to determine the importance of any difference found between two groups or findings from the same group over time. The .01 significance level is the most rigorous because there is only a 1% chance that a result is merely due to chance. The .10 (10%) level is sometimes used in fields such as political science, sociology, economics, or education, where significance is hard to come by in many models and thus the bar is lowered somewhat. All three of these levels are reported when they arise from the statistical analyses conducted for this report.

Teachers' Assessments of Aspects of the PSI Courses

Teachers were presented with a series of positive statements regarding the conduct of their particular PSI training program (chemistry or physics), and asked to indicate the extent to which they agreed or disagreed with each of those statements on a four-point scale, with **'1'** indicating ***strongly disagree*** and **'4'** designating ***strongly agree***. The results of this exercise are presented in Table 11.

Generally, the teachers' average responses tended to be quite positive – between the numbers 2 and 3 (i.e., ***tend to disagree*** and ***tend to agree***, respectively) regarding statements in the following general categories:

- *The organization and presentation of the courses;*
- *The goals of the courses and the means through which they were achieved;*
- *The balance between the number of laboratory experiences relative to the amount of coursework;* and
- *The appropriateness of the materials*.

In the instance of the number of labs compared to class sessions, the two groups of teachers had a combined agreement level of 2.80 (2.89 for chemistry; 2.76 for physics). Somewhat surprising was the finding that the difference between them of +.13 points in favor of the physics group was found to be statistically significant at the .10 level. No other differences between the groups were significant at any of the three predetermined statistical levels.

The statement in Table 11 that received the second lowest (negative) combined average response out of the 14 presented (again, on a scale of 1-4) was: ***I had enough opportunities to use the SMART Board***, with a combined agreement score of 2.23 (2.40 for chemistry; .2.13 for physics). This represents a differenced of more than a quarter of a point more for the chemistry cohort (+.27), which is noteworthy, but not statistically significant.

Overall, those teachers in the chemistry cohort were more in agreement with the 14 positive statements about the courses in Table 11 than those in the physics program in nine instances (64%), with six of those differences exceeding +.20 or more on the four-point scale and ranging from that level to +.36.

The reader will observe in Table 11, as well as in those that follow, that certain 'non-significant' differences found between the responses of two groups are sometimes larger than those that are designated as 'statistically significant' for this report – .01, .05, and .10. The reason that large differences between groups sometimes do not produce statistically significant differences, while smaller differences sometimes do, are often the result of:

- The distribution or 'spread' of answers across the possible response categories; and/or
- Size differentials between the two groups being compared.

That is, one group's responses may be distributed across the four response options used in the current survey, while another group's responses may cluster close together. Also, when one of the groups is substantially smaller than the other group to which it is being compared, a few 'outlier' responses could influence the statistical significance of certain response differences between the groups.

Significant Differences by STEM versus Non-STEM Degrees

The participating teachers were also divided into STEM and non-STEM groups, based upon whether or not they had a degree in a STEM field at either the baccalaureate or master's degree level. As seen in Table 11a, the STEM teachers were found, on average, to be more positive than their non-STEM counterparts regarding the statement that *The learning activities were well integrated into the courses* at a significance level of .10 – 2.35 for STEM; 2.29 for non-STEM. The teachers with STEM backgrounds also had a much higher positive rating of the contribution that the *examples used in the courses helped make the materials easier to understand* – +.42 points closer to agreement than the non-STEM teachers at a .05 level of significance (2.54 for STEM; 2.12 for non-STEM).

Significant Differences by Highest Degree

As was mentioned previously, two of the teachers had doctorates – one in the chemistry program and one in the physics program. For analyses by degree, those two teachers were combined with those having master's degrees. When these data were subjected to chi-square analysis, it was found that there were ***no significant differences*** between the two degree-level groups on any of the items contained in Table 11.

Table 11. *Teachers indicating the extent to which they agree or disagree with a series of statements regarding their PSI courses on a four-point scale, with both total average responses and disaggregated responses by those participating in the chemistry and physics programs, and the average response differences between the two groups of teachers.*

(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	*Combined* Average Response	*Chemistry* Average Response	*Physics* Average Response	Average Response *Difference* Between Chemistry & Physics
• Course goals were made clear.	2.47	2.44	2.48	+.04P(Physics)
• I was kept aware of how well I was doing in the courses.	2.82	2.89	2.79	+.10C(Chem)
• The teaching materials used were appropriate given the goals of the courses.	2.62	2.83	2.50	+.33C
• Assignments were consistent with the stated goals of the courses.	2.64	2.88	2.52	+.36C
• I had enough opportunities to use the SMART Board.	2.23	2.40	2.13	+.27C
• The use of technology enhanced learning in the classroom.	2.59	2.72	2.52	+.20C
• The examples used made the materials easy to understand.	2.42	2.53	2.36	+.17C
• The learning activities were well integrated into the courses.	2.35	2.59	2.23	+.36P
• I am very comfortable using the SMART Board.	2.32	2.28	2.34	+.06P
• The difficulty level of these courses was appropriate for me.	2.48	2.47	2.48	+.01P
• The goals of these courses were attainable.	2.59	2.62	2.58	+.04C
• The balance between the number of labs relative to the amount of coursework was just right.	2.80	2.89	2.76	+.13*C
• The amount of homework was reasonable.	2.35	2.28	2.39	+.11P
• Class sessions were well organized.	2.69	2.83	2.61	+.22C

▼ **Levels of Significance: * =.10; **= .05; ***= .01**

Table 11a. *Highlight of statements from Table 11 that engendered a minimum of a .10 level of significance when comparing average levels of agreement between program participants with STEM and non-STEM backgrounds.*▼

(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	*STEM* Average Response	*Non-STEM* Average Response	*Significant Difference* in Average Responses (*S* or *N-S)*
• The examples used in the courses made the materials easier to understand.	2.54	2.12	+.42S(STEM)**
• The learning activities were well integrated into the courses.	2.35	2.29	+.06S*

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

Significant Differences by Teaching Experience

The participating teachers were divided into 5 groups based upon the length of time they had been teaching. Because of the number of alignments for this variable, Table 11b is formatted differently from the other tables used to highlight significant differences between various groups on the items in Table 11. In the two instances presented in Table 11b – i.e., *examples used in class making it easier to understand the materials* and *one's level of comfort in using the student response system* – the teachers' agreement with these statements decreased as their number of years of teaching experience increased. That is, there was ***less agreement with both statements the longer time the participants had been teaching***, with an identical average level of agreement of 4.00 ('strongly agree') for the newest teachers to 2.11 and 2.12 levels for the most senior teachers**.** While the differences identified for 'understanding the materials' were at the .10 significance level, the differences found in the teachers' levels of comfort using the student response system were particularly significant at the .05 level.

Table 11b. *Differences by years of teaching experience for participants' average responses to statements contained in Table 11 that engender a minimum of a .10 level of significance.*▼ (1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	Average Responses by Years of Experience	*Significance* of Range of Responses
• Examples used made the materials easy to understand.	< l year = 4.00 2-5 yrs = 2.62 6-10 yrs = 2.35 11-15 yrs = 2.29 > 16 yrs = 2.12	2.12 to 4.0*
• I am very comfortable using the student response system.	< l year = 4.00 2-5 yrs = 2.71 6-10 yrs = 2.59 11-15 yrs = 2.29 > 16 yrs = 2.11	2.11 to 4.0**

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

Teaching Satisfaction and Success, SMART Technology, and Student Behavior and Performance

Table 12 contains the teachers' levels of agreement with three types of statements:

1) Satisfaction from and success with teaching chemistry/physics;
2) The use of SMART technologies and student reaction to them; and
3) The behavior and performance of students in their PSI classes.

Some rather striking combined average responses were found in Table 12. Again, using the four-point scale (with '4' indicating the greatest level of agreement), it was found that the following statements garnered the ***most agreement*** within the two groups' combined responses:

- ***PSI prepared me well for teaching chemistry/physics (2.38).***
- ***I enjoy teaching chemistry/physics more than I thought I would (2.45).***
- ***Students respond well to the student response system (2.31).***
- ***I have been successful teaching chemistry/physics (2.27).***
- ***Students have been very good about completing their homework assignments (2.13).***

Granted, while the above statements received the teachers' highest positive responses, they did not exactly attract ringing endorsements – ***with not even one 3.00*** ('*tend to agree'*) combined average agreement for any of them. On the other hand, the following two statements earned the ***least agreement***:

- ***I have had fewer classroom management problems when teaching PSI chemistry/physics than in other courses (1.49).***
- ***PSI adequately prepared me to conduct laboratory sessions (1.68).***

Significant Differences by PSI Program Area

Table 12 reflected some rather noticeable differences between the two cohorts in their levels of agreement/disagreement with the statements contained in that table, with differentials ranging as high as .81 points on the four-point scale. As had been the case in Table 11, the teachers in the chemistry cohort were consistently more in agreement with statements than those in the physics cohort. In this instance, ***12 of the 14 statements*** received higher levels of agreement from those in the chemistry program than those in the physics program. Table 12a highlights the five statements for which differences between the two groups of teachers were statistically significant.

Table 12. *The extent to which teachers report their satisfaction with teaching, the extent to which they use and value the SMART technologies, and the degree to which the program has influenced student behavior and performance.*
(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	*Combined* Average Response	*Chemistry* Average Response	*Physics* Average Response	Average Response ***Difference*** Between Chemistry & Physics
• PSI prepared me well for teaching chemistry/ physics.	2.38	2.72	2.19	+0.53C(Chem)
• I enjoy teaching chemistry/physics more than I thought I would.	2.45	2.47	2.44	+.03C
• I have been successful teaching chemistry/physics.	2.27	2.59	2.10	+.49C***
• My students enjoy learning chemistry/ physics.	2.06	2.35	1.90	+.45C
• My students are performing well in my chemistry/physics class(es).	1.98	2.29	1.80	+.49C**
• I enjoy teaching chemistry/physics more than other subjects I have taught or am teaching.	2.13	2.41	1.97	+0.44C
• I have been successful in facilitating the PSI program in my school.	2.16	2.00	2.25	+.25P(Physics)**
• I have had fewer classroom management problems when teaching PSI chemistry/ physics than in other courses.	1.49	1.82	1.29	+.53C
• Students have been very good about completing their homework assignments.	2.13	2.64	1.83	+.81C**
• I use the Student Response System often.	2.11	2.44	1.94	+.50C
• Students respond well to the Student Response System.	2.31	2.41	2.26	+.15C
• I have fully mastered the PSI technology.	2.02	1.89	2.10	+.21P*
• I am very comfortable using the student response system.	2.53	2.56	2.52	+.04C*
• PSI adequately prepared me to conduct laboratory sessions.	1.68	1.94	1.55	+.39C

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

In all but one instance, the chemistry teachers were shown to agree with these positive statements about their own success in teaching their respective PSI subject, student performance, and mastering PSI technology. The only instance in which the physics teachers report having more success is in facilitating the PSI program in their schools. This is probably due to the fact that chemistry is a newer PSI curriculum, and there are consequently more PSI-trained physics teachers at some of the schools and other teachers and administrators are more familiar with it.

Table 12a. *Highlight of statements from Table 12 that engendered a minimum of a .10 level of significance when comparing average levels of agreement between the chemistry and physics program participants.*▼
(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	Chemistry	Physics	*Difference* Between Chemistry and Physics
• Students have been very good about completing their homework assignments.	2.64	1.83	+.81C**
• I have been successful in facilitating the PSI program in my school.	2.00	2.25	+.25P**
• I have been successful teaching chemistry/physics.	2.59	2.10	+.49C***
• My students are performing well in my chemistry/physics class(es).	2.29	1.80	+.49C**
• I have fully mastered the PSI technology.	2.10	1.89	+.21C*

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

Significant Differences by STEM versus Non-STEM Degrees

There was only one item in Table 12 that showed a significant difference between the levels of agreement among teachers with STEM versus non-STEM backgrounds, which was: *I was well prepared to teach chemistry/physics*. The STEM average level of agreement was 1.81 – within the 'tend to disagree' range.– while the non-STEM average level of agreement was only 1.28. This .53 difference was statistically significant at the .05 level.

Significant Differences by Highest Degree

Only one statement in Table 12 showed a significant difference between the average levels of agreement between the teachers divided by highest degree. Those with a baccalaureate degree had an agreement level of 2.53, compared to 2.39 for those with master's degrees for the statement *PSI prepared me well for teaching chemistry/physics* – significant at the .05 level.

Significant Differences by Teaching Experience

As was the case with the highest degree comparison, only one statement in Table 12 showed a significant difference between the average levels of agreement between the teachers divided by number of years of teaching experience. As shown in Table 12b, that statement was: *I enjoy teaching chemistry/physics more than I thought I would.* The average level of agreement was highest among those with the least experience (one year or less) at 3.00, and the next highest level of agreement was among those with 16 or more years of experience, at 2.50. There was no distinct pattern among the other categories of respondents, but differences across groups were significant at .01.

Table 12b. *Differences by years of experience for participants' average responses to statements contained in Table 11 that engender a minimum of a .10 level of significance, by years of teaching.*▼
(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	Average Responses by Years of Experience	*Significance* of Range of Responses
• I enjoy teaching chemistry/physics more than I thought I would.	< 1 year = 3.00 2-5 years = 1.87 6-11 years = 2.25 11-15 years = 2.17 > 16 years = 2.50	1.87 to 3.0***

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

Teaching, Learning, and Confidence

The information contained in Table 13 reflects well on the PSI program, as far as the teachers' attitudes toward teaching and learning science. They were asked to indicate the extent to which they agreed with four statements about teaching and learning science, both prior to and after exposure to their respective PSI programs. The combined chemistry and physics data show that, according to the teachers' self-reports:

- They have become ***more confident over time*** about their ***understanding of science in general*** (.10 level of significance); and
- They have become ***much more confident*** about their ***understanding of chemistry and physics***, respectively, with a statement to that effect showing a +.79 point increase after their PSI participation (statistically significant at the .01 level of confidence).

Table 13 also contains two items with which teachers ***disagreed*** – both prior to and following their participation in PSI – with ***no statistically significant changes*** evident between their responses over time.

- ***Learning science*** is more difficult than learning other subjects, and
- ***Teaching science*** is more difficult than learning other subjects.

These latter findings highlight the fact that teachers drawn to this program are likely to have positive attitudes towards science prior to their involvement in the program. In fact, more than three-quarters of the teachers in these two 2011 cohorts already had STEM backgrounds [at least one degree in STEM, regardless of whether or not they had been teaching a STEM subject prior to the program (most were not)], and therefore probably had fairly well-grounded perceptions of the relative difficulty of teaching and learning STEM compared to other subjects.

Table 13. *Comparison of* ***combined*** *chemistry and physics teachers' average levels of agreement with statements concerning attitudes about teaching and learning and levels of confidence in their science and technology knowledge before and after their involvement in PSI.* ▼

(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	***Before*** Combined Average Response	***After*** Combined Average Response	***Difference*** in Combined Average Responses
• *Learning* science is more difficult than learning other subjects.	2.62	2.78	+.16
• *Teaching* science is more difficult than teaching other subjects.	2.63	2.75	+.12
• I am confident about my understanding of science in general.	2.41	2.65	+.24*
• I am confident about my understanding of chemistry/ physics.	1.61	2.40	+.79***

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

Significant Differences by Program Area

Tables 13a and 13b show the disaggregated change over time among the chemistry and physics teachers, respectively, with regard their levels of agreement to the same statements contained in Table 13. Table 13a shows that the ***chemistry teachers increased their average level of agreement with all four statements*** – only very slightly regarding the difficulty of both learning and teaching science, but with an increase representing a .05 level of significance for confidence in their understanding of science in general, and a very high level of significance (.01) for their understanding of chemistry specifically.

Table 13a. *Comparison of **chemistry** teachers' average levels of agreement with statements concerning attitudes about teaching and learning and levels of confidence in their science and technology knowledge before and after their involvement in PSI.* ▼

(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	***Before*** Chemistry Average Response	***After*** Chemistry Average Response	***Difference*** in Chemistry Average Responses
• *Learning* science is more difficult than learning other subjects.	2.88	2.94	+.06
• *Teaching* science is more difficult than teaching other subjects.	3.06	3.18	+.12
• I am confident about my understanding of chemistry.	**2.12**	**2.72**	+.60***
• I am confident about my understanding of science in general.	**2.53**	**2.94**	+.41*

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

In Table 13b, the ***physics teachers'*** data also show changes in levels of agreement with the four statements, and ***in two instances the change was significant***. The change of +.88 in their confidence levels concerning understanding physics revealed a .01 level of significance. The statement regarding confidence in one's understanding of science in general showed increases at a .10 significance level.

Table 13b. *Comparison of **physics** teachers' average levels of agreement with statements concerning attitudes about teaching and learning and levels of confidence in their science and technology knowledge before and after their involvement in PSI.* ▼

(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	***Before*** ***Physics*** **Average Response**	***After*** ***Physics*** **Average Response**	***Difference*** **in *Physics* Average Response**
• Learning science is more difficult than learning other subjects.	1.51	1.32	-.19*
• Teaching science is more difficult than teaching other subjects.	1.58	1.50	-.08
• I am confident about my understanding of science in general. *	2.34	2.48	+.14*
• I am confident about my understanding of physics.	1.34	2.22	+.88**

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

Technology's Value to Teaching and Learning

The data in Table 14 provide additional credence to the positive impact of the PSI program on its teacher participants over time. Eight statements concerning the use of the PSI-endorsed SMART technologies in the classroom were presented, and the teachers were asked to indicate the extent to which they believed (before and after PSI training) that those technologies contribute value to the teaching and learning process. ***Significant increases** in teachers' levels of agreement with the statements were found in **seven of the eight instances*** – three at the .01 level of significance and four at the .05 level. In general, the teachers were much more in agreement with statements concerning the benefits that SMART boards and Student Response Systems positively enhanced both instruction and learning. The only statement not showing a significant change in level of agreement before and after the program was: *Student Response Systems are important for formative assessment*, which showed a 2.07 level of agreement prior to the program and a slight, insignificant rise to 2.20 following the program. Formative assessments are a key and important component of the program, and are therefore decidedly stressed during PSI courses, so it is surprising that this statement did not reflect a higher level of agreement after the teachers had taken PSI courses.

Table 14. *Comparison of **combined** chemistry and physics teachers' extent of agreement with statements concerning the value of technology used in the PSI instructional approach.*▼

(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	***Before*** **Combined Average Response**	***After*** **Combined Average Response**	***Difference*** **in Combined Average Responses**
• I am confident about my ability to use SMART technology in the classroom.	2.29	2.58	+.29**
• Interactive white boards significantly improve student learning.	1.81	2.58	+.77***
• Interactive white boards make it easier to teach.	2.31	2.79	.+48***
• It is easy to learn how to teach with interactive white boards.	2.10	2.53	+.43**
• Student Response Systems significant improve student learning.	1.96	2.38	+.42**
• Student Response Systems make it easier to teach.	1.89	2.29	+.40**
• Student Response Systems are important for formative assessment.	2.07	2.20	+.13
• Student Response Systems can be helpful to the teacher.	2.20	2.61	+.41***

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

Significant Differences by Program Area

Tables 14a and 14b show the disaggregated change over time among the chemistry and physics teachers, respectively, with regard their levels of agreement to the same statements contained in Table 14. The chemistry teachers' responses showed increases in their levels of agreement over time with all eight statements, which is encouraging, but only the two highlighted in Table 14a were statistically significant – both at the .05 level. The remainder were within a range between +.27 to +.39, but not significant. The ***physics teachers'*** responses (Table 14b) showed increases in their levels of agreement over time with six of the eight statements, but ***all six of those growth measures were statistically significant***.

Table 14a. *Comparison of **chemistry** teachers' extent of agreement with statements concerning the value of technology used in the PSI instructional approach.*▼

(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	***Before*** **Chemistry Average Response**	***After*** **Chemistry Average Response**	***Difference*** **in Chemistry Average Response**
• I am confident about my ability to use SMART technology in the classroom.	2.29	2.56	+.27
• Interactive white boards significantly improve student learning.	2.00	2.39	+.39
• Interactive white boards make it easier to teach.	2.35	2.72	+.37
• It is easy to learn how to teach with interactive white boards.	2.06	+2.39	+.33
• Student Response Systems significantly improve student learning.	1.73	2.39	+.66**
• Student Response Systems make it easier to teach.	1.60	2.33	+.73**
• Student Response Systems are important for formative assessment.	2.00	2.39	+.39
• Student Response Systems can be helpful to the teacher.	2.43	2.72	+.29

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

Again, one finds distinct differences between the chemistry teachers' responses shown in Table 14a and those of the physics teachers displayed in Table 14b. All but one of the physics teachers' levels of agreement with the eight statements increased over time, and five of those increases were significant. The interactive white boards were judged to help improve student learning (a +.39 increase and a .05 significance level) and make it easier to teach (+.53 and .01). The physics teachers also found it easy to learn how to use them for instructional purposes (+.47 and .05). Like the interactive white boards, Student Response Systems were also found to make it easier to teach (a +.24 increase), as well as being helpful to the teacher (+.45) – both at a .05 level of significance. There was not change in the physics teachers' level of agreement over time with the relatively low level of agreement with the statement concerning the importance of Student Response Systems for formative assessment.

Table 14b. *Comparison of* ***combined*** *chemistry and physics teachers' extent of agreement with statements concerning the value of technology used in the PSI approach.*▼

(1=Strongly Disagree; 2=Tend to Disagree; 3=Tend to Agree; 4=Strongly Agree)

Statement	***Before*** Physics Average Response	***After*** Physics Average Response	***Difference*** **in Physics Average Response**
• I am confident about my ability to use SMART technology in the classroom.	2.28	2.60	+.32
• Interactive white boards significantly improve student learning.	2.30	2.69	+.39**
• Interactive white boards make it easier to teach.	2.29	2.82	+.53***
• It is easy to learn how to teach with interactive white boards.	2.14	+2.61	+.47**
• Student Response Systems significantly improve student learning.	2.07	2.37	+.30*
• Student Response Systems make it easier to teach.	2.03	2.27	+.24**
• Student Response Systems are important for formative assessment.	2.10	2.09	-.01
• Student Response Systems can be helpful to the teacher.	2.10	2.55	+.45**

▼ **Levels of Significance: * =.10; **= .05; ***= .01.**

Concluding Data Elements

Student Achievement, Grades and Expectations

Average Grades.

Three open-ended questions were asked at the conclusion of the survey, and these are each discussed below. The first asked the teachers what the average grade has been in the chemistry/physics classes they have taught. While four of the 44 teachers (9%) who answered this question in letter form indicated a D or an F as their average grade, 19 of them (43%) reported A's (3, or 7%) or B's (16, or 36%). Twenty-one of the teachers (48%) had given average grades of C.

<u>Students Passing their PSI Courses</u>.

The second question asked the teachers what percentage of their current chemistry/physics students were on track to passing the course. The percentage of students expected to receive passing grades ranged from 30 to 100 percent, for an average of 89 percent across all classes. This is broken down in more detail in Table 15, which shows that nearly one-half of the teachers anticipated that 90 to 100 percent of their students would pass, with another 27 percent predicting that 80 to 89 percent were on track to pass their PSI courses. This means that just more than three-fourths of the teachers believe that 80 percent or more of their students will pass.

Table 15. *Percentage of students predicted by their teachers to being "on track" to pass the PSI course(s) in chemistry/physics they were currently teaching.**

Predicted to Pass Current Course		
Percentage	***Teachers Predicting***	
	Number	**Percent**
90 – 100%	24	49%
80 – 89%	13	27%
70 – 79%	6	12%
50 – 65%	2	4%
> 50	4	8%
Totals	49*	100%

* Two teachers did not answer this question in a quantifiable manner.

<u>Advanced Placement Requests</u>.

The final open-ended question asked if any of their students had asked about taking Advanced Placement chemistry/physics. Nearly one-half of the teachers (24, or 47%) indicated that they had fielded such inquiries, with the percentage of their students who had asked falling in a wide range – from "5 or 10" percent to 80 percent.

Overall Teacher Confidence in Teaching Chemistry/Physics

The last piece of data to be reported in this section concerns the level of the teachers' confidence in their ability to teach their new subjects – or, in a few instances, to teach a subject they had previously taught in a different way. Presented with the same four-point scale used throughout this report, they were asked the extent to which they agreed with the following statement:

I am confident that I have been successful in teaching these courses.

The responses showed that these teachers – who were taught, and are now teaching PSI chemistry and physics – were quite confident about their ability to take what they learned in their PSI-focused courses and successfully impart these subjects to their students. For teachers who were still learning while they were teaching, they had a fairly high combined average level of agreement with that statement – 2.62 combined, with those teaching chemistry somewhat more confident than their counterparts teaching physics (2.82; compared to 2.52, respectively.)

IV. Focus Groups

As mentioned in the **Introduction** to this report, the survey of teachers participating in the PSI courses was supplemented by nine focus groups over three Saturdays during which they were also attending their spring PSI classes. Together, these focus groups included every teacher except for those very few who were not in attendance on the days during which their particular classes were targeted for this activity. Therefore, all 51 teachers who completed a survey also participated in a focus group. The purpose of these sessions was to expand upon certain survey responses through a structured discussion in order to clarify ambiguities, expand upon certain topics, and to identify and explore other issues of special interest to the participants.

Factors Positively Impacting the Program

When summarizing ***the most common conversation*** among the focus groups, the following refrain would be most representative:

- **This curriculum works because it was developed *by* teachers, *for* teachers, and *for* students.**

Although the above phrase may appear as though it has been borrowed from an NJCTL PSI marketing document, many attendant remarks in the focus groups can be paraphrased as follows:

- *[PSI] continues to be responsive and further refined on the basis of conversations among teacher users and through teacher feedback regarding classroom experiences and its impact on student learning to the PSI professors and staff for continual improvement.*

Indeed, the pattern of curriculum development and revitalization continues through the ongoing communications of a ***virtual PSI professional learning community*** with well more than 100 users and developers who communicate both within and beyond their immediate school/district work environments. NJCTL terms this ***SMART Lesson Study*** – a process sustained through telephone calls, emails, and in-house discussions among colleagues in schools and districts. Those discussions frequently include other, non-PSI teachers – especially, in the case of physics, where some mathematics teachers report higher concomitant learning in their algebra classes that they attribute to the contributions of PSI physics. In the best of circumstances, mathematics, science and curriculum supervisors/coordinators, as well as principals, become engaged as well.

The high level of communication among the PSI teachers has been critical to its achievements, but as was shown in last year's evaluation report, this has not been found to be a persistent activity in other professional development projects in which teacher networking and collaboration have been emphasized. Stephens and Hartmann (2004) found in their study of a multi-year PD program emphasizing online teacher collaboration that in spite of structural adjustments that were continually made to support that element of the process, no "traction" was ever established in this regard. Dede (2006), Lock (2006), and Green and Cifuentes (2008) have reported similar results.

However, Flanagan (2009) maintains that when collaborative face-to-face activities are augmented by using telecommunications (the Internet's emails and social media, interactive program and project websites, academic wide-area networks–WANs, and even the simple telephone networks), "the most valuable and significant benefit is that teachers can share their personal teaching expertise and innovative ideas with colleagues (p.8)."

Flanagan's scenario is more analogous to what continues to be evident in the PSI program. The *SMART Lesson Study* is based on the principles of *Japanese Lesson Study* – a process in which teachers jointly plan, observe, analyze, and refine actual classroom lessons, often called "research lessons". Lesson study is widely credited for the steady improvement of Japanese instruction (Chokshi and Fernandez, 2004; Lewis, Perry and Hurd, 2004; Penuel, et al, 2007; Tsubota, 2007; Nyre and McInerney, 2008; Darling-Hammond, et al., 2009; Nyre, 2010).

However, while the general principles of the two approaches are in close alignment, ***SMART Lesson Study* is more relevant for many U.S. educators** because it is designed to address the challenges educators face when using *Japanese Lesson Study* in the U.S. – particularly, the lack of time for educators to collaborate and plan. So, while implementations of this approach continue to be attempted in the United States, there are differences that make its direct transfer impractical.

SMART Lesson Study fosters collaboration among teams of educators beyond their immediate work environment through virtual learning communities in revision and exchange of units then occurs between all the teachers of the course. This process can occur at any time, during or outside of school hours, and accommodating the schedules of U.S. teachers. It especially enhances the experience for teachers who do not have others in their schools involved with the program, since they can develop linkages beyond their own schools and districts.

While the *SMART Lesson Study* model is robustly supported by the use of electronic implementation, it encourages and provides opportunities for face-to-face meetings of teachers both during participation in and after they have completed their PSI professional development programs. As mentioned in the previous chapter of this report, this year PSI held a Summer Conference: *Empowering Teachers--Leading Change*. Its professors and staff also have conducted several workshops at other conferences sponsored by others, and have presented symposia and developed webinars. As a result of events such as these, teachers are part of a ***continuing community*** of teacher-learners in which new ideas, approaches and techniques are exchanged on an ongoing basis – both in person and through cyber connections.

Many of the PSI teachers have other instructional assignments besides physics, and they have integrated the SMART Boards, student responders, and other techniques into other classes. One said: "This is going to make me a better educator regardless of what subjects I teach." There were also many reports of the PSI teachers having influenced other teachers in their schools in a variety of subject areas to integrate SMART techniques and equipment into their instruction.

Students with Special Needs and English-Language Learners

Students with special needs and those who were English-language learners (ELLs) used to be educated differently – and sometimes in different classrooms from – students without these characteristics. That is no longer the *status quo*. As a result, like other teachers at their schools, some of the PSI teachers had students from one or both groups represented in their classes. PSI teaching and learning outcomes – for both instructors and students – were purportedly mixed, although any instances in which there was a lack of success were not attributed to PSI.

One teacher had all "high" inclusion students in her PSI physics class, and reported that they were **more likely than the other students to both complete their homework and come in for extra help**. She contended that, as a result, ***They are doing better than my non-inclusion students.*** Although most of the teachers did not have inclusion students, several of them whose classes did include inclusion students indicated that were doing somewhere between "okay" and "well" – and attributed this to the interactive nature of the course, with one stating that the "SMART Board, labs and 'test retakes' help a lot."

Teachers reported that ELL students experience some of the same challenges and successes as the inclusion students. The greatest difficulty for teachers of these students was, not surprisingly, their own lack of speaking native languages of their students and the students' "low level of [English] reading skills." This "makes it difficult for them to keep up with the class," and sometimes "they don't really gain much of anything from the course." Most of the PSI teachers did not have ELL students in their classes, but those who ***did*** credited the SMART Board and the Student Response System with what successes they were having with some of these students – e.g., "They *love* the SMART Board" and "They really get excited about the clickers."

Mitigating Factors

The overall tone of the focus groups was very positive about the program, the delivery of its professional development courses by its professors, and the participating teachers' assurances that they had developed the skills necessary to deliver the content to their students. However, one series of discussions that surfaced in every group and always garnered widespread agreement was, to paraphrase the various comments:

> ➢ **There is really nothing 'wrong' with either of the programs (PSI chemistry *or* PSI physics), either as far as our own training and the manner in which we are expected to deliver it to our students.**

Rather, the teachers contend that their challenges to both their teaching and student learning originate elsewhere.

- ***It's the students.***
  - *Those students who really need extra need help from us or tutoring from their peers don't come to get it, even though we make ourselves available during lunch time and after school – including offering pizza and after-school snacks.*
  - *Some students just don't do their homework – for both subjects, but significantly more so in physics, as was displayed in Tables 12 and 12a.*[9]

[9] When the teachers were asked the extent to which they agreed with the statement that "Students have been very good about completing their homework assignments," the overall response average was 2.13 – on a four-point scale, with one meaning strongly disagree. Broken out by program area, the chemistry rating was 2.64, compared to the physics level of agreement of 1.83, which was a difference of almost one point (+.81), with a.05 level of significance.

- *Some students simply are not prepared to do science at this level, especially in physics, because their math backgrounds are so weak. Sometimes up to two or three weeks need to be spent on basic arithmetic and metric measurement.*[10] [11]
- *We have a very different type of student than those at Bergen Tech, on whom this program was beta tested.*
- *Absences play a big part in the low achievement rates of some students. There is typically a 50 percent attendance rate in my classes. So many classes are missed that students are not prepared for any quiz or test.*[12]

- ***It's the counselors/administrators.*** *They don't screen the students well enough so we end up with some who just are not up to doing the work or who don't care about the course.*

- ***It's the economy***. *Students need materials copied, such as the notebook for the course, but there's no paper to use – and even if we bring in a ream of paper on our own, the copiers are broken and there's no money to fix them.*

From the above comments, one might think that the students in the PSI chemistry and physics classes were performing poorly. However, as shown in the above "Student Achievement/Grades/Expectations" section of Chapter III, essentially one-half of the teachers (49%) reported in their surveys that ***90-100 percent of their students were on target to pass their PSI chemistry/physics course***, with ***another 27 percent predicting that 80-89 percent were.*** In essence, further conversations with teachers found that their experiences with PSI and what they refer to as its "learner friendly" fundamentals – e.g., the technological aides, test re-takes –had raised their expectations for student performance.

[10] This includes learning the Metric System of measurement, which PSI uses, versus the English system of measurement. In some instances, students have displayed an absence of operational knowledge of even certain aspects of the English system.

[11] By the time of the March 2010 evaluation site visits last year, all but one of the teachers were within one or two lessons of one another. The current evaluation did not employ site visits.

[12] According to this teacher and others, "Students are either just absent, or are in ISS [In-School Suspensions] for being late to class."

V. Commentary and Recommendations

Student Outcomes/Achievement Data

Ample positive anecdotal data regarding the program and student performance is prevalent from all quarters – teachers, science and mathematics supervisors, curriculum supervisors, and administrators. Discussions with the participating districts have been underway for more than one year to identify and mine sources that could provide objective outcome data on students that could answer questions such as:

1. Are there significant differences in algebra achievement levels between those students taking PSI physics and those who are not?

2. Are there significant differences in achievement levels in other courses between those students taking PSI physics and those who are not?

3. Are there significant differences in New Jersey Assessment of Skills and Knowledge (NJ ASK) mathematics test scores between those students taking PSI physics and those who are not?

4. Are there significant differences in New Jersey Assessment of Skills and Knowledge (NJ ASK) mathematics test scores between those students taking PSI physics and those who are not?

5. Are there significant differences in enrollment patterns in higher-level mathematics and subsequent physics courses between those students taking PSI physics and those who are not?

Some relevant data is emerging, but without more rigorous controls for comparison groups' experiences that can lead to rigorous statistical procedures and incontrovertible results, attempts at inferring causality will remain weak. Although the participating districts are very interested in helping to make such a determination, as of this writing, PSI has yet to find a district partner that has been able to provide either the staff time or other financial resources to supply the types of data that can be used to determine if the successful outcomes achieved during the program's development at Bergen Tech are being validated as the program expands. This might be inexcusable in other economic circumstances, but given the current stringency of New Jersey's education budget, it can be understood. Therefore it is recommended that:

- **If partnering schools and districts continue to be unable to provide student outcomes data, NJCTL, Kean University, and/or the State Department of Education should consider providing funding so that certain schools and/or districts can be supported with the necessary funds to provide either new or extant data in a manner that can deliver the information necessary to determine the answers to the above questions.**
- **Alternatively – or at the same time – the parties mentioned above could work together to ascertain government, private industry and/or philanthropic organizations to approach that would provide funding for this purpose.**

However funded, this activity is critical to determine the extent to which the many positive program results emanating from the earlier outcomes found during the development of PSI at Bergen County Technical Schools in Teterboro are in the process of being repeated elsewhere. In addition, it can also provide data to determine if the more recent qualitative data provided through independent teacher surveys and focus groups, interviews with curriculum supervisors and administrators, and classroom observations can be quantitatively corroborated. As implied in the above recommendation, not all schools would need to be involved in this research.

Student Selection and Enrollment

Recent and Current Efforts concerning student selection and enrollment have Greatly Improved from the program's beginnings. There were instances early in the program in which the evaluation found that the PSI philosophy was at odds with the manner in which PSI is being viewed and operated administratively in some schools – not necessarily districts. As mentioned previously, there remain some instances where not all students are able to achieve in the courses without some initial remediation, and not all are passing their PSI courses. While PSI has never intended or even suggested that only the best math and science students be provided an opportunity to take these courses, there still continues to be some isolated instances in which students who are unable to achieve at even minimally acceptable levels in science and mathematics end up in PSI classes.

Some schools were previously screening students so that only those with the highest prior standardized test scores and classroom achievement were enrolled in the PSI courses. Other schools were 'tracking' students into particular PSI classrooms based upon their abilities – i.e., those in even a differentiated 'fast track' versus a 'slow track' PSI course. In such instances, there appeared to be no determination regarding which teacher could most adequately serve which grouping of students.

The above examples of misunderstandings regarding both the program and student placements reflects the small window of opportunity PSI staff had to communicate with the districts the during the program's initial year. ***According to the participating teachers surveyed and interviewed in the current evaluation, this has been rare in the program's subsequent iterations.*** NJCTL staff currently have the lead-time to be diligent in making their intent for student participation very clear – i.e., neither 'skimming' the best students, nor including those who have not exhibited some evidence of an ability and/or an intent to succeed in academic pursuits.

Student Response Systems and Formative Evaluation

In agreement with last year's evaluation findings, this cohort of teachers also stated in the focus groups that all of the PSI course components (i.e., SMART Boards, course notebooks, student responders, round tables)[13] provide more positive results when they are used together, with the PSI method requiring a unified approach, as all elements are tied together instructionally to support student learning. Earlier, Table 14 demonstrated that teachers reported significant increases from before their PSI instruction and afterwards in their levels of agreement with seven of eight positive statements about the value of the SMART Boards and the Student Response Systems to teaching and learning. However, there are three caveats that must accompany that finding:

- Their initial levels of agreement with those statements were very low. Three of the statements averaged an agreement level of less than 2.0 (*tend to disagree*) on a four-point scale, with 4 representing strongly agree. None of the other five statements received an average level of agreement of more than 2.29.
- Reflecting upon the same eight statements after their PSI training, the highest level of average agreement received by any of the statements was 2.79 – not even firmly in the category of *tend to agree*.
- The one statement showing no difference at any level of significance was ***Student Response Systems are important for formative assessment***, with a 2.05 level of agreement before and 2.20 after their PSI training.

[13] Teachers who only teach one PSI class do not have round tables, but anticipate having them when additional classes are offered.

Since use of the SRS and formative evaluation of student progress are critically important tenets of the PSI program, and since the SRS system is specifically designed to help teachers accomplish this, the above comments lead to the following two recommendations:

- **The importance of formative evaluation and the value of the student response systems for this purpose should be increasingly stressed in the PSI professional development classes.**

- **When conducting visits to schools and classrooms, special attention should be paid to observing and reinforcing the use of the student response systems.**

Perceived Ebbing of Support from Certain School/District Personnel

Several teachers from different schools and districts reported having directly experienced various levels of jealousy/resentment from certain other teachers – both in the math/science areas and other subjects. Perhaps more surprising is that some recounted that school and district curriculum supervisors were sometimes included in this group. "These people have been, in essence, asking: *Why are **<u>you</u>** getting all these supplies and support?*" This is apparently much more evident than earlier in the program, when other teachers and supervisors (and some principals) would go out of their way to praise the program during evaluation site visits. This change has been interpreted by the PSI teachers as most likely due to the fact that "everyone in the schools and districts feels impoverished because of budget problems." At the same time, "we get the latest technology and district-paid graduate credit."

Another contributing reason for this sensitivity may be due to the fact that there has been a decrease in the previous high level of PSI staff interactions with school and district supervisors and those in other administrative positions, including principals. This had been a hallmark of the PSI program in its initial stages, because it was important to "get the word out" about the program and support the first group of PSI teachers. One of the PSI professors (now also a program manager) had previously made visits to each teacher's classroom several times a year, and the external program researcher/evaluator visited most on the classrooms at least once. However, there were several teachers participating in this year's series of focus groups who confirmed their survey responses indicating that they had not received any PSI visitors to their classrooms.

The school visits provide an opportunity to observe the PSI teachers and help to embed the PSI philosophy and approach into their classrooms and – in those instances where several teachers are involved in the program – into the school culture itself. They are critical to the success of the program. Additionally, conversations that the visiting professor and the director of NJCTL have with district and school science and mathematics supervisors, principals, vice-principals, and others is another important element of the program, in that they answer questions about the program, allay any misperceptions, obtain feedback, and lay the groundwork for the continuance of the program through district support and subsequent teacher enrollments. They also talk to teachers who are not in the program, providing information about the program and how they might be involved in the future.

It is understandable that the small size of the NJCTL staff compared to the increasing numbers of teacher participants and alumni in the PSI programs has necessitated some reduction in school visits. However, given their proven importance to the overall program, a recommendation presented previously concerning school/classroom visits is reinforced here for an additional purpose:

- **An emphasis on school and classroom visits should be revitalized, and if the PSI staff continues to be shorthanded, perhaps some of the many practicing PSI-trained teachers with the most experience and who are counted among the Center's part-time staff could be called into service in this regard.**

This would entail occasionally taking them out of their classrooms to visit other schools, with a need to hire substitutes, but there are now enough PSI teachers that this should not unduly shortchange their students.

NJCTL's initial **Annual Summer Conference** in August of this year, which brought together more than 110 of its teacher-users, PSI professors, and devotees to further explore and augment the program, was an excellent amplification of the programs being offered, and allowed an excellent networking opportunity for the teachers. However, nothing can replace the necessity for sufficient classroom visitation and mentorship, especially early on, when instituting a new curriculum and approaches to teaching it. As last year's evaluation site visits discovered, additional assistance was requested for conceptual, instructional and/or technological support in practically every instance.

Teachers' Suggestions

Prior comments in this report include both meticulous quotations and illustrative commentary based upon discussions in the focus groups. Many of these gave rise to the report's previous recommendations in this chapter. However, some suggestions directly from the teachers were so straightforward that they require little to no explanation because their context is obvious. These are presented below.

The two groups of teachers – and the physics cohort, especially – felt that they were getting a good background for the required PRAXIS examination, but both cohorts joined together to offer two suggestions in this regard:

- ***Provide a supplemental math course that could meet once a week or twice a month focusing on algebra and trigonometry.***
- ***Provide some workshops – perhaps one a month – dealing with the general science content that we also have to pass for the PRAXIS.***

Several teachers reported having wanted more direct experience using the SMART Board, and this resulted in their lack of comfort levels using it in their classrooms, "especially when a problem comes up when using it. Even though PSI had a special session toward the end of the training on use of the SMART Board, teachers felt that "just talking about it is not the same as using it." They therefore suggest that PSI:

- ***Provide more tactile and operational/troubleshooting experience with the SMART Board.***

Dissatisfaction with what many of the current two cohorts' teachers considered "inadequate attention" to or "a less-time-than-desired" reflection on their laboratory experiences was also expressed by many of the teachers in the 2009-2010 physics program survey. It also resonated in both last year's evaluation interviews and this year's focus groups. Some teachers were also disappointed that they were not provided with "answers" for the laboratory activities – mostly among those in the chemistry cohort.

The reader may recall that teachers were asked the extent to which they agreed with the following statement: ***The balance between the number of laboratory experiences relative to the amount of coursework was just right***. The responses of both groups of teachers had a combined level of average agreement of 2.80 (2.89 for chemistry; 2.76 for physics) – which represents very close to a "tend to agree" response. 'tend to disagree' Still, in every one of the focus groups, they said that they would like the program to do things in this regard:

- ***Provide additional laboratory session experiences in the training sessions.***
- ***Provide more information about the laboratory materials that are delivered to the schools – e.g., "What goes with what?" and "What are the answers to the laboratory sessions we are supposed to teach?"***

Still others reported feeling "lost" when they went home to study – some up to 4-6 hours at night during the summer courses. They thought the materials from which they were being taught did not provide enough context or variety, and some felt that a broader range of learning options in addition to those used in the PSI classes might be beneficial. In a similar vein, a few mentioned that they found the presentation of the materials using the SMART Board proved "boring" after a while, and developed PowerPoint presentations, filmstrips and other methods to augment the PSI notebook. Even though they were commended on these additional activities – since PSI does encourage enhancing the curriculum in ways that individual teachers believe will be beneficial to their students, they still wanted to suggest that PSI:

- ***Provide additional books or reference materials since "we often have to try to find information on the Internet for clarification and/or review" – their own review and that of their students.***

References

Chokshi, S. & Fernandez, C. (March 2004). Challenges to Importing Japanese Lesson Study: Concerns, Misconceptions, and Nuances. *Phi Delta Kappan*, 85(7), 520-525.*

Darling-Hammond, L., Wei, R.C., Andree, A., Richardson, N., and Orphanos, S. (2009). *Professional Learning in the Learning Profession: A Status Report on Teacher Development in the United States and Abroad.* Dallas, TX: National Staff Development Council.

Dede, C. (2006). Online Communities to Facilitate Teacher Professional Development. *Journal of Technology and Teacher Education*. December.

Flanagan. N. (2009). Online Teacher Collaboration. *Education Week*, Vol. 3, Issue 1.

Green, M. & Cifuentes, L. (2008). An Exploration of Online Environments Supporting Follow-Up to Face-to-Face Professional Development. *Journal of Technology and Teacher Education, 16*(3), 283-306. Chesapeake, VA: Association for the Advancement of Computing in Education.

Lewis, C., Perry, R., & Hurd, J. (2004). A Deeper Look at Lesson Study. *Educational Leadership*, 61(5), 6-11.

Lock, J.V. (2006). Collaborative Design of Online Professional Development. *Journal of Technology and Teacher Education*. December 22.

Nyre, G.F. (2010). *External Evaluation of the Progressive Science Initiative: The First Group of Teachers*. Bethesda, MD: Nyre and Associates, LLC.

Nyre, G.F., and McInerney, J. (2008). *Evaluative research study for the NSF's Director's Award for Distinguished Teaching Scholars (DTS) Program*. Arlington, VA: National Science Foundation.

Penuel, W., Fishman, B., Yamaguchi, R., and Gallagher, L. (2007). What Makes Professional Development Effective? Strategies That Foster Curriculum Implementation. *American Educational Research Journal*, 44(4), 921-958.

Stephens, A.C. & Hartmann, C.E. (2004). A Successful Professional Development Project's Failure to Promote Online Discussion. *Journal of Technology and Teacher Education*, 12(1), 57-73. Chesapeake, VA: Association for the Advancement of Computing Education.

Tsubota, K. (2007). *Developing Lessons to Captivate Children. Innovation of Classroom Teaching and Learning Through Lesson Study*, Asia-Pacific Economic Cooperation Conference, Kyoto, Japan. December.