

EXTERNAL EVALUATION OF THE PROGRESSIVE SCIENCE INITIATIVE

Alumni Survey



Submitted to:

NEW JERSEY CENTER FOR TEACHING AND LEARNING

Submitted by:

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I. INTRODUCTION

Program Overview

Program Beginnings and Development

In the summer of 2009, a group of teachers and science department chairs 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 demanding journey for them. That summer they began participating in a unique and challenging program – the Progressive Science Initiative (PSI) – through which they took a course called PSI Algebra-Based Physics. This was the beginning of a nascent program that held the potential for them to obtain state physics teaching endorsements or, for some, eventual graduate degrees. The intent of the program was then, and continues to be, to increase the number and quality of physics, chemistry and biology teachers in the state.

The participation of these teacher-learners continued through the fall and spring semesters of that academic year – as well as the ensuing summer – during which they took additional evening and weekend courses focused on the content, curriculum, instructional and assessment strategies used in the first half of PSI Advanced Placement (AP) Physics B and the second half of PSI AP Physics B. During this time, they were concurrently teaching the curriculum that they learned in their summer course to simultaneously teach their own Algebra-Based Physics courses in their respective schools. The teachers were supported by adjunct professor from PSI's partnering institution of higher education, Kean University, who visited their physics classes on a regular basis during both of their teaching semesters to observe and provide feedback and assistance as part of their fieldwork experiences.¹

The teachers had ample time to work together during the summer session, but throughout the year, they primarily communicated with those not in their home schools as a Virtual Professional Learning Community (V-PLC), using telephone calls, emails and the program's website – and later, the program's Facebook page as well – to share and solicit advice, ideas, techniques and resources from one another to enhance their teaching of PSI physics. In addition, they were able to do so person-to-person during the additional PSI courses they were taking after school and into the evening.

Following still another sequence of courses and fieldwork, this initial cohort of teachers was able to teach Honors and Advanced Placement (AP) physics as well, allowing their schools to provide a full complement of high-quality physics courses. At the same time, the PSI program implemented its next phase of development –bringing on board a second cohort of teachers wanting to learn the PSI physics curriculum and methods. In the following year, a third cohort

¹ The professor typically visited with others on these site visits as well – i.e., science and mathematics teachers, department chairs, and principals.

for the physics sequence and a new cohort of current teachers wishing to become PSI chemistry instructors joined the program.² Soon thereafter a subsequent and final PSI science curriculum was developed – a course sequence for PSI Biology and AP Biology.^{3,4}

Program Administration and Delivery

PSI was initially developed by teachers at Bergen Paramus over several years. It was further formalized by, and has been administered since 2009 by the New Jersey Center for Teaching and Learning (NJCTL or CTL), with courses being taught by adjunct professors from Kean University, which provides participating teachers with graduate credits. The wording “initially developed” is used advisably here because many teachers have been very involved in program development not only from the very beginning, but as a continuing process as they both learn and teach PSI. All of CTL’s curricula for both science and mathematics have been “developed by and for teachers.”

The classrooms in which teachers are being taught STEM content and PSI curriculum and methods – as well as the teachers’ eventual PSI classrooms – are equipped with SMART Board™ technologies, including an interactive, computer-driven “whiteboard” (the SMART Board™) to demonstrate concepts and more fully engage students in the learning process, and student responders (sometimes referred to as “clickers”) that are used to facilitate immediate formative assessment results of student learning for both content and general concepts.⁵

Nyre and Associates, LLC (N&A) of Bethesda, Maryland, has been involved with PSI as an independent research and evaluation contractor from the initial stages of the program, having engaged in preliminary conversations with those involved as final preparations were being made to implement it. Over the succeeding three years, N&A has surveyed and conducted focus groups with teacher participants, and made site visits to their schools to observe their PSI classes and discuss their experiences with the curriculum and student performance. During those site visits, science chairs and supervisors, mathematics teachers, and principals were also interviewed. The first external evaluation report by N&A in August of 2010; the second report was submitted in August of 2011; and the third report was submitted in August of 2012.

² Those wishing to become PSI Chemistry teachers are required to take the initial PSI Physics course prior to taking the PSI Chemistry courses because PSI Chemistry uses concepts from the PSI algebra-based physics course as a foundation for PSI Chemistry.

³ The program’s intention is that these courses be taught in a physics, chemistry and biology sequence in the schools, rather than in the inverse order that is currently the standard in most districts in the country.

⁴ Comprehensive lists of equipment required for student laboratory experiments and teacher-led demonstrations used to support the instructional process of all PSI courses are provided to the teachers and their schools.

⁵ SMART Board™ is the interactive white board used by CTL’s PSI and PMI (Progressive Mathematics Initiative) programs. Some others that are widely used in education and other settings include ActivBoard, eBeam, Mimio, and Webster.

Evaluation Purpose and Approach

Purpose

The focus of the alumni follow-up evaluation was to answer the following research questions:

1. *To what extent are PSI-trained teachers still teaching in New Jersey?*
2. *To what extent are PSI-trained teachers teaching PSI courses?*
3. *What are the current opinions of alumni regarding the degree to which the CTL's PSI courses for teachers had adequately prepared them for teaching PSI courses to students?*
4. *What are the current opinions of the alumni regarding the courses they were required to take in order to learn the PSI curriculum and methods?*
5. *To what extent do the PSI teachers find satisfaction in teaching the STEM courses?*
6. *To what extent do PSI teachers interact with other PSI teachers and teachers in general regarding the PSI program and its curriculum and instructional methods?*
7. *To what extent do other teachers support the PSI program?*
8. *How many students were being taught PSI science courses by the responding alumni during the spring term of 2012?*
9. *How are students performing in the PSI courses?*
10. *What degree of student interest is there for pursuing Advanced Placement courses in the PSI science fields?*
11. *What level and types of support are PSI teachers receiving for their PSI efforts from NJCTL?*
12. *What level and types of support are PSI teachers receiving for their PSI efforts from their districts?*

Approach

The evaluation approach included a survey of all PSI alumni in order to obtain data from a broad perspective of former participants who had completed at least one full program sequence.⁶ In order to provide a broader context within which to more fully explain and interpret the quantitative survey statistics, a variety of schools in which science teachers are using PSI were visited.⁷ More specifically, the evaluation activities incorporated the following:

1. *A survey of the 97 teachers who had participated in and had completed one or more of the PSI endorsement program's sequences, regardless of subject(s).*
2. *Two-day site visits to two schools that had teachers who were PSI alumni in each of two New Jersey districts, for a total of four schools.*

⁶ Some alumni have completed more than one program sequence in order to be able to teach multiple PSI subjects.

⁷ This combined evaluation approach – known as “holistic evaluation” – was pioneered by Nyre (1980, 1982) some 30 years ago, and is still being widely used in research and evaluation studies in education and across a wide spectrum of social science and health-related disciplines.

While at the schools, a total of 24 PSI teachers were observed while conducting at least one PSI class. This activity was not an effort to evaluate their teaching, but instead, to determine their fidelity to various aspects the PSI curriculum and approaches – for example, using appropriate technology, instructional methods and materials, and formative evaluation strategies, as well as facilitating social constructivist learning opportunities – more likely to be known among non-educators as “social and collaborative learning.”⁸

Each observed teacher was also interviewed to foster discussion about the class or classes that had been observed, and to explore items from the survey in more depth – e.g. their reflections on the NJCTL training courses, the academic progress their students were making, and their interactions with other PSI teachers in their school and district and outside of their school and district, STEM teachers in their school who were not teaching PSI courses, and non-STEM teachers in their school.

Also covered in the interviews were the types and levels of support their PSI efforts were receiving from the CTL, their schools and their districts. In certain instances, some of the teachers also engaged in group discussions during common preparation periods or once the formal school day had concluded.

Science department chairs were interviewed as well, and non-science and mathematics teachers were occasionally available for brief discussions. More informal conversations were also held with mathematics department chairs and, to the extent allowed by schedules and unanticipated demands, the principal or a designee. A total of 18 non-PSI school personnel were included in these more casual interchanges.

⁸ Key to the social constructivism theories first forwarded by Vygotski (1931) and partially integrated into PSI’s approach is the enhanced use of student interaction and discussion in the classroom. Its supporters contend that this allows students to generalize and transfer their knowledge of classroom learning to other settings. This social interaction also provides them with opportunities to test their ideas, synthesize the ideas of others, develop reasoning skills, and learn collaborative skills (Barab, et al., 2007; Weber et al., 2008). For PSI, the use of round tables with students working together (rather than seats in a row) is one important way of facilitating the desired interactions.

II. PROFILE OF PSI SCHOOLS AND DISTRICTS

“The PSI (almost) One Hundred”

The PSI program has impacted many more districts, schools and teachers than are the focus of this report, as other teachers were participating in various phases of the program when the study was undertaken. This study focused on the first 97 alumni of the PSI program – thus the use of the non-arithmetically-correct phrase of “The PSI One Hundred” that was used by the N&A study team to differentiate the computer files for this group of teachers from those of prior PSI cohorts that had been studied. The schools represented among each district, as well as the number of teachers in each school are displayed in Table 1. All of the schools were high schools, except in Jersey City, where there were five middle schools and three elementary schools, accounting for 11 of its 39 teachers.

Table 1. *List of districts, schools, and numbers of PSI teacher alumni as part of “The PSI One Hundred” as of spring, 2012.*

District	Schools	Number of Teachers
Bergen Co. Technical Schools	Bergen County Technical School Paramus	3
	1 School	3 Teachers
Bergenfield	Bergenfield High School	1
	Roy W. Brown Middle School	1
	2 Schools	2 Teachers
Hillside	Hillside High School	1
	1 School	1 Teacher
Jersey City	Academy 1 Middle School	2
	Chap. Charles Watters Elementary School	1
	Christa McAuliffe Middle School	1
	Ezra L. Nolan Middle School	1
	Frank R. Conwell Middle School	3
	Franklin L. Williams Middle School	1
	Henry Snyder High School	4
	James F. Murray Elementary School	1
	James J. Ferris High School	5
	Joseph H. Brensinger Elementary School	1
	Liberty High School	2
	Lincoln High School	4
	Martin Center for the Arts	1
	McNair Academic High School	4
	William L. Dickinson High School	8
	15 Schools	39 Teachers

Table 1. List of districts, schools, and numbers of PSI alumni as part of “The PSI One Hundred” as of spring, 2012 (continued)

District	Schools	Number of Teachers
Newark	Arts High School	5
	American History High School	1
	Barringer High School	1
	Central High School	1
	East Side High School	3
	Malcolm X Shabazz High School	6
	Greater Newark Charter School	1
	Newark Vocational High School	3
	Technology High School	6
	University High School	1
	Weequahic High School	2
	Westside High School	5
	12 Schools	35 Teachers
Paterson	Eastside High School	6
	Garrett Morgan Academy	2
	HARP Academy	3
	John F. Kennedy High School	3
	Panther Academy	3
	5 Schools	17 Teachers
Totals	36 Schools	97 Teachers

III. FINDINGS

Response Rate

Eight of the 97 emails sent to the PSI alumni on the list provided to N&A by NJCTL were initially returned as undeliverable. NJCTL was subsequently able to provide alternative, deliverable email addresses for those teachers, and four responses were subsequently returned from them, resulting in a survey census of 93 teachers. **Sixty-six** of them completed and returned their surveys, which was **a very high response rate of 71 percent**.⁹ As shown in Table 2, the alumni respondents represented the same six districts that were represented by the 97 alumni who were originally surveyed.¹⁰

Table 2. *Distribution of PSI alumni respondents among districts*

District	Respondents	
	Number	Percent
Newark	27	41%
Jersey City	20	31%
Paterson	12	18%
Bergen County Technical Schools	2	3%
Bergenfield	2	3%
Hillside	1	1%
N.A.	2	3%
TOTAL	66	100%

Teacher Backgrounds

Years of Experience

None of the alumni respondents were novice teachers (with less than one year of teaching experience), whereas 39 percent had 2 to 5 years of experience; 39 percent had between six and 10 years of experience; 13 percent had been teaching for between 11 and 15 years; and nine percent had 16 or more years of teaching experience.

⁹ There exists no agreed-upon norm regarding what might be used as a minimum threshold or what may be an acceptable or reasonable response rate—and inversely, what is unacceptable (Baruch, 1999; Baruch and Holtum, 2008). Nor are there written standards or conventions for even reporting response rate information (Hudson and Gullickson, 2002; Kviz, 1997). Most education and social science researchers consider rates as low as 38% to 48% to be adequate for statistical reporting (Carley-Baxter, et al., 2008; Chatman, 2007; Couper, et al., 2007).

¹⁰ The teacher cohort still in training when this study began – and were therefore not included in this study of alumni – represented six districts that were new to PSI: East Orange, Irvington, Orange, Perth Amboy and Sparta and Sussex County Technical Schools

As shown in Table 3, the three evaluation surveys conducted prior to the 2012 Alumni Survey found that the largest percentage of teachers in each cohort had five or less years of experience (30% in 2010; 57% in 2011; and 56% in 2012), or six to 10 years of experience (28%, 33% and 11%, respectively). The combined percentage of those who had taught for between one and 10 years were fairly stable throughout the three cohorts – 78% , 70% and 67%, respectively – which compares favorably for that same category for the alumni respondents in this survey (78%).¹¹

Table 3. *Comparison of teaching experience across three teacher cohort surveys from 2010-2012 and the alumni survey of 2012*

Teaching Experience in Years	Year of Survey Administration							
	2010 Cohort Percent		2011 Cohort Percent		2012 Cohort Percent		2012 <u>Alumni</u> Percent	
1-5 Years	50%	(combined) 78%	37%	(combined) 70%	56%	(combined) 67%	50%	(combined) 78%
6-10 Years	28%		33%		11%		28%	
11-15 Years	5%		14%		22%		13%	
16 or More Years	12%		16%		11%		9%	
No Data	5%		--		--			
TOTALS	100%		100%		100%		100%	

STEM versus Non-STEM Backgrounds.

Teachers who are selected to participate in the PSI program are current New Jersey teachers who may or may not have backgrounds in STEM (science technology engineering and mathematics) subjects.¹² As was the case with their years of teaching experience, comparative data among the four survey groups these alumni were also fairly similar between the 2010 cohort survey and the subsequent two cohort survey groups and those responding to the alumni survey with respect to the proportion of PSI teachers who had STEM backgrounds prior to entering their respective PSI programs.

As displayed in Table 4, the initial evaluation survey in 2010 found that 81 percent of the teachers entering the program (physics) had STEM backgrounds, whereas that proportion had increased by the time of the 2011 and 2012 reports – to 92 percent and 89 percent, respectively. Among the 2012 alumni survey respondents, 85 percent came from STEM backgrounds.

¹¹ The 2012 teacher cohort was not included in the Alumni Survey because that survey was implemented prior to the 2012 cohort survey.

¹² The term “STEM backgrounds” was defined for this study’s purposes as having certification, a degree, and/or teaching experience in a STEM subject. STEM teaching experience could have taken place under a standard, resident or a conditional certificate.

Table 4. Comparison of STEM versus non-STEM backgrounds across three teacher cohort surveys from 2010-2012 and the alumni survey of 2012

Academic/Teaching Background	Year of Survey Administration			
	2010 Cohort Percent	2011 Cohort Percent	2012 Cohort Percent	2012 Alumni Percent
STEM Background	81%	92%	89%	85%
Non-STEM Background	19%	8%	11%	15%
TOTALS	100%	100%	100%	100%

Although most teachers are now entering the PSI program with backgrounds in STEM, they have various reasons for wanting to be included. According to comments from teachers during school site visits and written on their surveys, these teachers' reasons could be categorized as follows, in descending order:

- Those who were teaching in a non-STEM field, but had taken a number of STEM courses in college, with some obtaining a minor in a STEM area.
- Those who were already certified to teach the STEM subject matter that was the focus of a particular series of courses being offered, but wanted to learn the PSI approach – more specifically, PSI's use of new instructional materials, technology and assessment methods.
- Those who were certified to teach a STEM subject other than the one that was the focus of the particular series of PSI courses being offered, but wanted to add certification in a new subject (or more) to make themselves “more valuable” to their schools and districts – and more marketable to other schools and districts, if necessary – during an increasingly onerous climate for school funding and reduction in force exigencies.
- Those who became certified in one STEM area through PSI and decided to continue to become certified to teach additional STEM fields.

Degree Attainment

The majority of the alumni (60%) had baccalaureate degrees, with 37 percent having attained master's degrees, and three percent having obtained credits or degrees beyond the master's level. This finding was comparable to the three cohorts surveyed previously, except in the case of those surveyed in 2012, among whom 11 percent had received specialist or doctoral degrees (see Table 5).

Table 5. Comparison of highest degree attainment across three teacher cohort surveys from 2010-2012 and the alumni survey of 2012

Highest Degree Attainment	Year of Survey Administration			
	2010 Cohort Percent	2011 Cohort Percent	2012 Cohort Percent	2012 <u>Alumni</u> Percent
Baccalaureate	57%	65%	50%	60%
Master's	41%	32%	39%	37%
Master's Plus	2%	3%	11%	3%
TOTALS	100%	100%	100%	100%

Answers to the Evaluation Questions

As mentioned in the *Introduction* to this report, the focus of the alumni follow-up evaluation contained several specific questions regarding outcomes from the program. Findings relative to each of these questions – in quantitative and/or qualitative terms – are presented below, using data from survey responses and supplementing or contextualizing those data with information gathered during site visits and gleaned from survey respondents' comments.¹³

1. *To what extent are PSI-trained teachers still teaching in New Jersey?*

- **NINETY-FIVE PERCENT** of the alumni were still teaching in the state, with the others having either relocated or retired.

2. *To what extent are PSI-trained teachers teaching PSI courses?*

- **EIGHTY PERCENT** of those alumni who were still teaching in New Jersey were currently teaching PSI courses, while the remaining 20 percent were teaching, but not PSI courses.

The reasons given by those who were not teaching PSI were:

- *They had been reassigned to schools that do not offer PSI.*
- *Their schools offer PSI courses, but certain teachers with PSI training have not been assigned to them.*
- *Their schools offer PSI courses that they could be teaching, but they have not yet passed the Praxis examination in order to obtain an endorsement in their STEM area.*

¹³ At the end of the survey, the teachers were asked to write additional comments they may have on any aspect of the PSI experience, such as: (1) The PSI course(s) you have taken; (2) your experience teaching PSI, (3) the achievement/responsiveness of your PSI students, and/or (4) the support you receive with respect to implementing and teaching PSI from (a) the Center for Teaching and Learning, (b) your school, and/or (c) your district.

In those schools where teachers qualified to teach PSI courses are not being used for that purpose, schools typically have more PSI teachers than needed to meet their current needs. Among some of these schools, rising needs are anticipated in the future, as more students complete PSI physics and will need to complete PSI Biology and Chemistry courses. And as students complete introductory courses in each of these subjects, teachers will be needed to provide AP courses for those wishing to take them.

At two of the site visit schools where PSI teachers were not currently being assigned to PSI classrooms, they had been assigned to them in the past. However, department chairs, other teachers – and in one instance, the principal – agreed that these were defensible decisions based upon “lack of need” because not enough students were taking PSI courses at present. In only one instance was this due to negative teacher evaluations.

3. *What are the current opinions of alumni regarding the degree to which CTL's PSI courses for teachers had adequately prepared them for teaching PSI courses to students?*

In order to answer this rather broad evaluation question, the survey posited a series of statements regarding the PSI training and asked the teachers to rate the extent to which they agreed with each of them on a four-point scale, ranging from (1) = “not at all” to (4) = “very much”. Each statement is presented in Table 6, along with its average level of agreement.

Table 6. *The extent to which teachers feel that they were well prepared to teach PSI courses.*

1=Strongly Disagree 2=Tend to Disagree 3=Tend to Agree 4=Strongly Agree

Statements Regarding Preparation	Average Response
CTL prepared me well for teaching PSI courses.	3.8
I feel comfortable using the PSI technology.	3.8
I am very comfortable using the SMART Board™.	3.5
Classroom visits by PSI staff have been helpful.	3.5
I use the Student Response System often for formative assessment.	3.1
I feel well prepared to conduct PSI laboratory sessions.	2.7

The teachers mostly high levels of agreement with the statements indicate that they felt very well prepared to teach PSI courses (3.8), were equally comfortable using the PSI technology (3.8), and also found the classroom visits by NJCTL staff helpful (3.6).

Having reported being comfortable with the technology overall, and with their ability to use the interactive white board (3.4 each), they were not quite as much in agreement about using the student response system “often” (3.1). The statement regarding being “well prepared to conduct laboratory sessions” garnered a level of agreement of 2.7. That level of agreement is close to the “tend to agree” level on the continuum. Still, it has been identified as an area in need of improvement in the teachers’ preparation by CTL/PSI staff as well, and will be discussed later in this section of the report.

Each topic addressed in Table 6 is discussed briefly below, followed by representative interview quotations and written survey responses pertinent to each.

Preparation for Teaching PSI. Overall, the teachers were extremely pleased with their preparation to teach PSI courses, as evidenced by the following representative quotes:

QUOTES

Professionally, PSI is one of the best, if not the best, teaching methodologies that a teacher could use in the classroom for improving students’ deeper understanding, application and synthesis of new and old material presented during the course of the physics curriculum. With a basic and fundamental teaching routine of applying the algebraic formulas, repetitively going through the calculations using what the student has already acquired or is still trying to master, the PSI format provides hundreds of examples and chances for the student to grasp and retain these important operations while simultaneously discovering the physics concepts and the wonderful world of physics and science, in general.

I am a huge advocate for the Progressive Teaching Initiatives, both science and math. I have become smitten with the model of classroom environment, formative assessment, student-driven instruction, and grading policy of the program, as well as the technology integration. I have trained teachers in the pedagogy and content, and I have spent time devoted to improving the curriculum. My high praise of the program is on record.

I think the PSI courses offered by NJCTL were essential to my success in the classroom. I think they have prepared us with the content knowledge needed to teach the material to students.

I have been teaching physics for many years, but the knowledge and experience from PSI helped me make the course more to the students’ level.

I like the algebra based physics – it is perfect for our students. It helps them do better in math. I have students come back to me saying how they knew how to answer some questions on the algebra EOC exam because of something they learned in my physics class.

The PSI/PMI materials are awesome. Great resources to guide/support instruction.

Excellent instruction by PSI faculty

I greatly enjoy the PSI program and teaching the course. I love every part of the program.

Overall, the PSI training I received was good. Now that I’ve been using it for three years I have a better understanding of where my students are coming in at and the places within the curriculum where I need to add examples, activities and additional explanations to ensure that students master the material. Students are working more together which promotes a positive community-focused environment.

This program helped me to understand physics in terms of how all the different formulas are interconnected to each other and the concepts they are related to. I teach [another science subject], but my fluency in physics has increased a hundred fold because of my participation in the PSI training.

The PSI course fully prepared me for my classroom experiences.

I learned a lot from the instructors and felt confident teaching the content.

It provided a good familiarization with physics and the technology of teaching “the PSI way.” They said we could alter teaching styles, but I would have liked some modeling of differentiation and modifications.

Supportive professors/teachers. A good/positive program.

I believe that teachers might benefit more from learning the material if they took turns teaching it. Instead of sitting and listening to lectures, they could prepare before classes, and then take turns going through the material as they are supported by PSI staff. This will allow them to gradually become more proficient manipulating the Smart Board and facilitating formative assessments.

I teach PSI physics, and my experience thus far has been great.

The PSI Physics course was extremely helpful and informative.

The PSI Physics curriculum is detailed, informative, and comprehensive, and provides high-quality curriculum and materials.

Technology Use. PSI classrooms are ***technology-based***, but not ***technology-driven***. That is, while technologies are used to support the instruction and to measure student learning, the teacher is the driver of that instruction and assessment. As mentioned in the *Introduction* to this report, interactive white boards are used to deliver course content in the classroom, student responders are used for formative assessment, and Internet access allows both course and supplemental materials to be downloaded from that source, as well as PSI’s own website, for distribution, reviewing, and student access beyond the classroom.

Another key word in this discussion is the ***use*** of technology. It is of little or no help if it is not used – and used correctly in order to effectively benefit instruction. Overall, the teachers reported that they were very well prepared and very comfortable with the technology in PSI – an average level of agreement with the two statements in this regard of 3.8 each – and only slightly less so specifically with regard to using the interactive white board (a 3.5 level of agreement).

Agreement with the statement “I use the Student Response System often for formative assessment” received an average level of agreement of 3.1 from the teachers, which put it ever so slightly to the plus side of “tend to agree.” However, its use was infrequently witnessed during observations of their teaching. Since this feature of the PSI technology is so important to formative assessment – i.e., demonstrating the extent to which students understand the material before moving on – the program most likely would have liked to have seen a higher level of agreement regarding it, as well as more frequent observations of its use.

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I was fine using the SMART Board during the Center’s classes, but once I was alone in the classroom with my students, it was a bit intimidating at first.

The NJCTL website is invaluable for teaching resources.

The students definitely benefit from the SMART Board technology.

The PSI program is very interactive, so kids love coming to the SMART Board to solve problems. I often use responders for formative assessment because it is a very good tool for students to get their instant results.

Without the professor there to fix the little problems that arise when using a computer and a SMART Board, I was rather anxious for the first several classes on my own. But now I'm much more comfortable.

The students love learning with the Smart Board and responders.

I love that there are formative assessments built into the units and my students like using the responders to answer the questions. I teach PSI Physics to 8th grade students. They are motivated and work hard to learn the material.

Classroom Visits. These visits refer to when the PSI teachers are in their classroom teaching a PSI subject. The NJCTL staff member who conducts virtually all of these visits—a former science teacher and one of the people involved in all aspects of PSI from the very beginning – comes to observe in his dual role as a Kean University adjunct professor. The classroom visit is part of the PSI instructional process, undertaken in support of fieldwork directed either toward graduate credit or professional development hours, depending on which component of the program in which a teacher is involved.

The purpose of the visits is to provide feedback to the teachers regarding both specific and general instructional or technical aspects of the teaching-learning process, answer any questions they may have, and deal with any classroom, department, school or district issues related to or impacting the program (positively or negatively). Visits with non-PSI teachers, whether in science or mathematics or other subjects, are sometimes included as part of the school visits, as any number of other subject matter teachers have become interested in and are using the PSI approach. The visitor typically visits with the science chair, and the math chair and the principal are sometimes included in these visits to the school as well, depending upon availability.

On those occasions during which evaluation staff have accompanied this particular NJCTL staff member on classroom visits over the last three years, there has never been a visit in which teaching advice or technical assistance has not been requested, and it has always received a full and adequate response. Nor has there ever been an occasion where unsolicited advice has not been well received and appreciated.

The professor making these visits is not only a source of feedback and assistance in any given classroom, but subsequently takes information regarding issues or problems identified and resolved at one school and conveys that information to other schools and teachers that are routinely visited.¹⁴

¹⁴ The person who has made most of these classroom visits from the very beginning of the program not only has made important, constructive contributions during the school visits, but has also developed excellent professional relationships with the PSI teachers and other teaching and administrative staff at the schools. These types of relationships are evident with district mathematics and science coordinators as well.

QUOTES

NJCTL, particularly Tim, has been extremely helpful at every single phase of implementation into teaching and through technical issues I have had.

Tim is an invaluable resource to this program. In addition to Tim, all of the professors in the training portion were all one needs in order to be prepared for the classroom experience.

When Tim visits our school, he always tries to talk with the science and mathematics chairs, and the principal, if available. This is good for school support.

Tim helped me a lot as I began teaching, responding by phone or in person whenever I had questions or problems.

Laboratory Experiences. Many alumni indicated – in site visit conversations, as well as survey written comments – that they would have rated their preparation for teaching PSI as “flawless” or “excellent” had it not been for the shortcomings in their laboratory experiences, especially compared to the rest of their training. Although the level of agreement regarding being “well prepared to conduct laboratory sessions” is substantially lower than that received by the other statements, it is certainly not negative, but a “neutral” 2.5.

Still, this is a situation that has perplexed PSI administrators, program developers and professors from the very beginning. When the teachers were in training, there was so much content to cover that there was little time for laboratories and demonstrations. Although there are several laboratory sessions embedded into the notebook used when the teachers were learning PSI, less than an optimal number are taught with hands-on experiences, and others are merely described and discussed. The laboratory issue in the schools has been somewhat exacerbated in the case of the later cohorts, as challenging budgets have kept some districts and schools from purchasing some, if not all, of the laboratory equipment recommended for the PSI curriculum by the CTL.

QUOTES

The only area I feel that is lacking in the program is the laboratory component. I think they do not provide us with enough practice and/or developed labs to do with students to really be able to bring them into the classroom. They give a broad and general look at some activities and show us how to use some equipment, but my colleagues and I struggle to provide hands-on physics experiences for our students.

When I taught PSI Physics last year, I was unable to do any labs with my students due to lack of resources, which I understood should have been provided by the district/administration. In spite of not being able to conduct labs, I believe my students grasped the concepts very well, and were very comfortable and excited using the technology on a daily basis.

Even after three years, I still find a lot is lacking in the “hands on” activities and lab sections of the curriculum on the website. I know that I am fully capable of coming up with activities and labs and sharing these with other teachers (and I do) but there is little addressed throughout the notebooks and curriculum about how this actually plays out in a classroom.

The laboratory preparation we received was the only area lacking.

When we were being taught chemistry labs, the professors didn't always use lab apparatus. I would prefer to have the lab focus be using equipment more than learning a concept.

We do not go through enough lab experiences while training.

I enjoy using the PSI demonstrations that coincide with the curriculum because I have a background in physics and chemistry. For me, they are powerful and effective. However, this is a weaker aspect of the program for those without a background like mine.

4. What are the current opinions of the alumni regarding the courses they were required to take in order to learn the PSI curriculum and methods?

Table 7 shows a high level of agreement among the alumni with each of four statements pertaining to the goals of the PSI training courses, and the activities and examples used to help them attain them – ranging from 3.2 to 3.4 on the same four-point scale used previously. They felt that the goals of the courses were attainable, and that the multiple technologies, examples used, and course activities were supportive of their learning.

Table 7. *The extent to which PSI alumni/teachers agree with statements concerning the courses they took from the Center for Teaching and Learning to learn the PSI curriculum and methods.*

1=Strongly Disagree 2=Tend to Disagree 3=Tend to Agree 4=Strongly Agree

Statement	SD
a) The use of technology enhanced learning in the classroom.	3.4
b) The examples used made the materials easy to understand.	3.4
c) The learning activities were well integrated into the courses.	3.2
d) The goals of these courses were attainable.	3.2

5. To what extent do the PSI teachers find satisfaction in teaching the STEM courses?

The Act/Process of Teaching. The survey explored teaching satisfaction by asking the alumni the extent to which they agreed with the following statement, on the same four-point scale used previously: “I enjoy teaching PSI Physics/Chemistry/Biology more than I thought I would.” The teachers came up just slightly short of a “strongly agree” level of agreement, with a 3.7. This is an important finding because, although most had STEM backgrounds, many were teaching STEM subjects that they had not taught previously. Furthermore, the physical setting of PSI classrooms – i.e., small, round tables as opposed to desks, and the extensive use of small group work around those tables. Additionally, the instructional components of the PSI curricula, regardless of the STEM subject, were new conditions to almost all of the alumni – e.g., the absence of a static text book, the delivery mode of interactive technologies, the fostering of social constructivism, and so forth.

QUOTES

Teaching PSI Physics was both a challenging and rewarding experience for me. After teaching abstract mathematics for nearly 5 years, the introduction of concrete physical concepts in my teaching made the class very engaging for my students. Presently, I use concepts from physics to “spice up” mathematical ideas

I taught physics before, but this is much more interesting for me and more engaging for the students.

PSI has the potential to create a paradigm shift in US science and mathematics education.

Teaching PSI Physics accomplishes not only the goal of teaching science to the students, but it also teaches mathematics in the most engaging way I have ever experienced.

PSI makes teaching and learning fun.

I truly enjoy teaching the program. It has made teaching easy and enjoyable.

Before PSI when I taught chemistry, I would leave out math sections. Now I attempt them because I know math better.

I use the slides often for biology as well.

Classroom Management. Impacting upon both teacher satisfaction and student learning is the extent to which their classroom is a conducive or disruptive learning environment. To examine this factor specifically with regard to PSI and its use of technological techniques and approaches, the alumni were asked to indicate the extent to which they agreed with the following statement: “I have had fewer classroom management problems when teaching with PSI technology than previously.” Again, a positive response was received -- a 3.0 level of agreement – i.e., “Tend to Agree”. This is higher than one might have anticipated, considering that some of the student issues reported during the site visits and detailed in the surveys dealt with students – but foremost among those were tardiness and absenteeism. The teachers clearly separated these happenings from classroom behaviors.

6. *To what extent do PSI teachers interact with other PSI teachers and teachers in general regarding the PSI program and its curriculum and instructional methods?*

7. *To what extent do other teachers support the PSI program?*

A series of four statements were presented on the survey regarding interactions with other teachers, and the PSI respondents were asked to indicate the extent to which they speak to them about PSI, using a four-point scale from (1) = “Never” to (4) = “A Lot”. Their average responses are presented below in Table 8, where one finds that they interact with other PSI teachers in their school to a great degree, with an average level of 3.6. As might be expected, they interact with PSI teachers from other schools and districts to a somewhat lesser degree (3.2), but it is somewhat surprising that they speak with both non-PSI science and math teachers and other non-science or math teachers fairly frequently – both indicating a 2.9 – just shy of “frequently.”

Table 8. *The extent to which teachers speak about the PSI curriculum and teaching techniques with other teachers*

<i>1=Never</i>	<i>2=Rarely</i>	<i>3=Frequently</i>	<i>4=A Lot</i>
Question		Average Response	
<i>How often do you speak about PSI to:</i>			
• PSI teachers in your school/district?		3.6	
• PSI teachers from other schools/districts?		3.2	
• Non-PSI science and math teachers in your school?		2.9	
• Non science or math teachers in your school?		2.9	

During the site visits, it was found that other teachers in their schools were generally very supportive of the PSI program. In fact, many PSI teachers were serving as resources to other teachers regardless of discipline, demonstrating the advantages of using an interactive white board driven by a computer, championing the use of formative assessments, and showing them how to devise their own supplementary classroom materials. PSI teachers who teach courses other than those in the current PSI family of science courses attest to this when they use PSI technology and principles in their other assigned courses such as earth systems, environmental science, forensic science, and so forth.

The degree to which PSI teachers have conversations with teachers and other school personnel not closely associated with PSI, particularly attests to the fact that they have inspired other teachers to explore and implement reform efforts using PSI principles. Once introduced to the PSI approach, teachers in non-science and non-mathematics fields report no shortage of ideas and help from the PSI teachers in locating downloadable resource materials available for their own subjects. As noted during site visits, PSI teachers are sometimes in the forefront of curricular and instructional training efforts for other teachers in their schools, either formally – in those where the principal, department chairs and teachers themselves have promoted school-wide implementation of many PSI-inspired approaches – or somewhat less broadly and less formally in other schools.

At one school included among those visited during the research for this report, one of the evaluators spoke briefly with two non-science teachers who are among others in that school who have replicated many aspects of the program. As one of them said:

We saw the work [she] was doing with her classes, and worked with her after school to learn more about it and then began adapting it to our classes.

8. How many students were being taught PSI science courses by the responding alumni during the spring term of 2012?

- There were 2,758 students in the PSI classes being taught by the 57 of the 66 alumni (88%) who responded to a question asking them to provide the number of students in their second-term 2011-2012 PSI classes.

These overall numbers are broken down by the number of teachers and students in specific classes in Table 9. It should be pointed out that this does not include the totality of students or teachers in any of these categories because: 1) not all alumni responded; and 2) many other teachers were teaching PSI courses as part of their fieldwork prior to becoming PSI alumni. These data therefore do not represent the entire picture of what was going on in the New Jersey schools relating to PSI students at the time of the survey, but they do demonstrate the instructional impact of these 57 alumni respondents.

With this caveat in mind, Table 9 shows that, overall, 40 of these 57 alumni (70%) were teaching 2,115 students in PSI Physics, by far the largest representation of teachers and students due to its status as the first NJCTL course teachers entering any of the STEM programs being offered must take. It is also the beginning course for students entering the NJCTL STEM course sequence of physics, chemistry, and biology. The other subjects began enrolling teachers quite a bit later than the physics courses, and thus, the numbers of teachers and students for these subjects are much smaller at this point. However, they are expected to increase substantially as student move through the PSI STEM course sequence.

Table 9. Number of teachers and students in specific PSI classes during the spring term of 2011-2012

Course	Number of Students	Number of Teachers Teaching the Subject*	Average Number of Students per Teacher (of each subject)
Physics	2115	40	53
AP Physics	160	8	20
Chemistry	285	11	26
AP Chemistry	43	3	14
Biology	155	4	39
Totals	2758	66*	2758/57=48**

*Although there were only 57 teachers responding to this question, **nine of them taught two PSI subjects**. Therefore, **the combined number of teachers teaching each subject** provides a total of **66**. Those teaching more than one subject were as follows: Chemistry and AP Chemistry (3); Physics and AP Physics (2); AP Physics and Chemistry (2); Physics and Chemistry (1); Physics and Chemistry (1).

The total number of students is **divided by 57 teachers because **nine of them were teaching two subjects**.

While it is important to note that the overall average number of students being instructed per teacher is 48, they range widely by subject area – from a high of 53 in physics to a low of 14 in chemistry. However, one must remember that many teachers are responsible for multiple sessions of the same class, and some teachers at schools new to PSI may only teach one or two PSI class sessions, along with other instructional duties.

9. *How are students performing in the PSI courses?*

ALL OF THE STUDENTS RECEIVED PASSING GRADES in their PSI courses during the spring term of 2011-2012. As displayed in Table 10, the majority of students (48%) received a “B” letter grade, with 10 percent receiving an “A.” Thirty-nine percent received a “C” and three percent a “D”. Therefore, overall, 97 percent received a grade of “C” or better, with all of them passing their PSI courses (including the 3% with “D” grades). On a four-point grading scale, with an “A” equaling 4.0, the average student grade among all teachers in all PSI schools – and across all classes and subjects – was 2.5.¹⁵

Table 10. *Percentage of PSI students obtaining each letter grade during the spring term of 2011-2012*

Grade	Percentage of Students
A	10%
B	48%
C	39%
D	3%
F	--
Total	100%

QUOTES

My students really enjoyed learning with the PSI methods and felt that the physics material was something they were capable of achieving success with. A majority of the students did reach high levels of achievement for each of their individual abilities.

I teach middle school. My students include all of the honors students in the building. PSI has been able to challenge these students to a higher level than they had with the regular 8th grade curriculum.

As a mathematics teacher, I enjoyed the connection between Algebra and PSI Physics. I taught both PMI Algebra and PSI Physics, and noticed a direct correlation in the skill set for both courses. As a result of my students being accustomed to rearranging formulas, identifying given and unknown values in a question in PSI Physics, by time they got to solving equations and translating word problems in Algebra class, my students were pros.

The high schools in my district haven't given credit for my eighth-grade students' PSI physics courses, and have therefore reenrolled them in PSI physics as juniors (3 years later).

¹⁵ Those taking Advanced Placement courses would have received extra weighting for their grades, but their comparatively small representation among the students would not have materially affected the overall grade point average.

10. What degree of student interest is there for pursuing Advanced Placement courses in the PSI science fields?

Nearly two-thirds of the teachers (64%) reported student interest in taking Advanced Placement classes. This included a large range from a very limited number in a few teachers' classes to more than half in a small number of others. Overall, 25 percent of the students were planning to do so.

QUOTE

AP Physics B has not been taught at [this] High School for more than ten years. I have been told that it will be offered next year. There are more than twenty students signed up to take it (mostly seniors). I anticipate being the teacher.

11. What level and types of support are PSI teachers receiving for their PSI efforts from NJCTL and the PSI staff?

From NJCTL I received support whenever I asked from Tim, Bob, and Yuriy.

The NJCTL staff is outstanding.

The people from NJCTL are always there for any issues to be resolved.

They are very supportive, and most of the time I get immediate responses from them.

The NJCTL website is invaluable for teaching resources, ideas and connections.

Teachers and administrators of the program were excellent, knowledgeable, and accommodating.

Mary Rose and Laura were very supportive at helping me understand the physics when I was going through the training.

I am thankful I can use PSI in the classroom and am appreciative of the scope that Bob and Yuriy have brought by bringing this modern technology of the Smart Board and responders and the concomitant support in both power point and word presentation formats. The basic physics course is now more rigorous, complete and enjoyable. I hope that my district will continue to implement and use the PSI program for physics for as long as I'm teaching! No higher recommendation or reference can I make. Thank you.

There should be more substantial interaction between PSI administration and the schools that they are serving. This way, the schools administration will be more inclined to support PSI teachers, as they will be clearer regarding the metacognition behind PSI.

12. What level and types of support are PSI teachers receiving for their PSI efforts from their schools and districts?

The quotation immediately below represents a unique situation, at least as far as interviews and survey comments are concerned, and does not conveniently fall into the "Positive" and "More or Less Negative" representative comment categories contained in Table 11. There were really no "middle ground" comments, except that some in the "More or Less Negative" column may be interpreted somewhere along that continuum by various readers.

The school administrators are providing good support for the PSI program. A major concern that we have is that most of the high achieving students in my PSI classes are pulled by the magnet schools and charter schools within the first quarter of the school year, leaving me with struggling students. This impacts the success of the PSI program in my school and is reducing the number of students who will be available for AP Classes in the fall.

Table 11. Teacher Comments about School and District Support

Positive	More or Less Negative
<p><i>My school and district have been supportive of the program. In the fall we are supposed to expand the middle school program by another 25 students. We have been provided with SMART Boards, Responders, and any lab equipment we need.</i></p> <p><i>In my school, the administrators support the PSI program 100%, making my job easier. They can see how easy it is to use the formative assessment and determine how long I will be teaching any chapter. The only problem is the amount of cuts and absents (about 25-30 %) in my school from some students. I stay after school to give tutoring to the students missing class assignments.</i></p> <p><i>The support for PSI in my school has come more from the math chair because the program has been so positive for algebra.</i></p> <p><i>The district has allowed us not to create standard lesson plans because of how detailed the PSI curriculum is.</i></p> <p><i>I hope the district will keep the program running; I get afraid every time I hear comments saying that the program is not being supported by some members of the district.</i></p> <p><i>My school is very supportive of the PSI program.</i></p> <p><i>They paid for the program – the training, the Smart technology, the special furniture, etc.</i></p> <p><i>The district provided the materials I needed to implement PSI, as well as the tuition for my training.</i></p> <p><i>My high school supported me by giving me the freedom to fully implement PSI according the PSI recommendations. The only thing lacking was that we had 80-minute periods instead of the recommended 40 minute periods. My colleagues and I were able to offer each other a lot of support as we had all gone through the training.</i></p>	<p><i>It was very hard to teach last year because my administration did not support me and wanted me to combine the PSI method with the methods they preferred. This year I was told not to use PSI at all. I would have been able to teach better this year if I were using the PSI program.</i></p> <p><i>I teach middle school. My students are all the honors students in the building. Psi has been able to challenge these students to a higher level than they had with the regular 8th grade curriculum. Unfortunately the high schools haven't been accepting their advancement in the PSI course in 8th grade and have reenrolled them in PSI physics as juniors (3 years later).</i></p> <p><i>I have had some students who were eager to go on to AP physics but their high schools haven't offered it.</i></p> <p><i>PSI is well supported by the principal, but only reluctantly by the department chair. The DC feels that other forms of assessments should be integrated along with the quizzes and tests, such as portfolios and projects.</i></p> <p><i>I think that the PSI program for physics was a success, but our school district is no longer supporting it. Next year, they are no longer calling the class "PSI Physics", but we are allowed to continue using the materials. They are also no longer going to offer it to freshmen. We are going back to biology, chemistry, and then physics. Only the students on track for [XXXXX high school] will be getting physics first.</i></p> <p><i>Uncertainty/fear of lack of district support and resources.</i></p> <p><i>As a result of the wide-spread changes in [this] district, I have been teaching under 3 different principals in 3 years. My newest principal is not a fan of PSI, and thus has done away with it.</i></p> <p><i>Very little support has been given PSI. I have had 2 different principals in 2 years in the same school.</i></p>

Continued →

Table 11. Teacher Comments about School and District Support (continued)	
Positive	More or Less Negative
<p><i>My high school supported me by giving me the freedom to fully implement PSI according the PSI recommendations. The only thing lacking was that we had 80-minute periods instead of the recommended 40 minute periods. My colleagues and I were able to offer each other a lot of support as we had all gone through the training.</i></p> <p><i>The district IT department has always been responsive to any issues that come up for any of us.</i></p> <p><i>Everyone in my high school was very supportive of PSI – the department chair, other teachers, and the principal.</i></p>	<p><i>Approximately 70 percent of my students wanted to take AP Physics. I actually helped make a schedule that would have led to [this school] having the second highest AP participation rate in the state for the 2011-2012 school year. However, the principal who I worked on that with was replaced during that summer and the administration dropped the ball with the scheduling. Needless to say, the students and I were all extremely disappointed.</i></p> <p><i>It is very disappointing that most of the schools in my district do not see the wisdom of teaching PSI.</i></p> <p><i>My school supports the PSI model, but the district is currently considering taking PSI out of the middle school.</i></p> <p><i>At the school level, there is no cooperation from administrators. They are resistant to the course and have even hindered the process at various points. They lack the scientific background to understand why the layout of the program (Physics to Chemistry to Biology) is the best way to teach students the sciences. It is hard to express how much they have been unhelpful.</i></p> <p><i>The PSI program was given to a population of freshmen with a large percentage who did not pass the eighth grade GEPA and did not have the skills or understanding to benefit. I had to teach a lot of very basic math.</i></p> <p><i>The school assigned me students with very low GEPA math scores. Many could not subtract. Most did not know what a square root was. The online text was too advanced for them. Many of the slide presentations were too theoretical.</i></p>

IV. SUMMARY AND COMMENTARY

Introduction

Looking back over PSI's initial three years, one finds that four districts have had teachers participating every year since the program began in the summer of 2009, and 13 districts had participated by the end of the 2011-2012 school year. Every district that has had teachers in the program at any point has continued to participate. This speaks very well for the program, and bodes well for the future, as more and more students move on in the physics-chemistry-biology sequence and their Advanced Placement course counterparts. A challenge for the program will be to ensure that there are enough teachers receiving endorsements to meet the projected demand from the more than 2000 students currently enrolled in the array of PSI Physics courses, plus the additional students who are beginning to advance through the subsequent PSI courses.

The remainder of this concluding section of the report will provide brief summaries of the findings with respect to the evaluation questions, and then deal with some additional issues that arose during the study.

PSI Teacher Retention

Ninety-five percent of the PSI alumni were still teaching in New Jersey at the time of the survey (May 2012). All those who were not teaching in New Jersey either relocated or retired. This is a remarkable retention rate among any group of teachers. As was shown in Table 3, one half of the PSI alumni in this study have been teaching between one and five years. According to the most recent data from the National Center for Education Statistics, 50 percent of teachers nationally leave teaching. Within that statistic, it is found that one-third of America's teachers leave the field sometime during their first three years of teaching – increasing from 14%, to 24% to 33% across those three years. In many low-income communities and rural areas, the rates of attrition are even higher. The attrition rate for those who enter through “alternative” pathways can be as high as 60 percent (Dill and Stafford, 2008).

Some of the teacher interviewees indicated that PSI had “rejuvenated” or “re-energized” them as far as teaching was concerned. These comments came both from those who had STEM backgrounds and those who had been teaching non-STEM subjects prior to their participation in PSI.

Most PSI-Trained Teachers are Teaching PSI Courses

Eighty percent of those alumni who were still teaching in New Jersey were currently teaching PSI courses. The remaining 20 percent were still teaching, but not PSI courses. Among the reasons given by those who were not teaching PSI courses were a lack of support from their

principal and/or a department chair; a slight oversupply of PSI teachers for the current demand in their schools, which is anticipated to increase as students move through the full PSI sequence of courses; negative performance evaluations; and not yet having passed the Praxis– typically the general science section.

Commentary

Teachers who have been trained to teach PSI courses but are not in schools that support or offer PSI, or are not certified to teach PSI because of not having passed a portion of the Praxis examination constitute *a realized loss* of STEM teachers their districts and the state. At the same time, these teachers also represent *a potential gain*, as the former could be utilized at schools that do not have enough PSI teachers. Actions to resolve such situations might include the following:

- 1. Those teachers needing assistance with the Praxis examination could be provided with tutoring to help them overcome that final hurdle. This might be provided by NJCTL or other sources, such as science teachers in a specific school in which a teacher needs some tutoring, or through districts where this situation exists, in an effort to help facilitate the best use of human resources.¹⁶**
- 2. Districts might benefit by identifying those schools in which teachers with endorsements obtained through their PSI training are underutilized, and see if the district might be better served if one or some of those teachers would be amenable to moving to another school where their new expertise could be better utilized.**

Alumni Preparation for Teaching PSI

The alumni are very pleased with their preparation to teach PSI courses, as evidenced by their extremely high level of agreement with a specific statement in that regard. They also indicated being well prepared for the uses of technology required for the PSI program, including both the interactive white board and the student responders. Of the five areas of preparation explored, and briefly summarized below, the only two areas that provide some challenges to them were: 1) the relative lack of experience they had during training related to conducting laboratory sessions; and 2) the fast level of pacing required to complete courses within a semester, especially given the lack of preparation in basic mathematics among some students.

Laboratories. The above two issues are somewhat related, as the amount of material to be covered in a short period of time during their training is what determined the limited amount of time available to spend in laboratory experiences and demonstrations. Though there

¹⁶ At the time of the current study, one of the NJCTL staff members was voluntarily providing tutoring to some of the teachers at night, once a week.

were some laboratories, the details of many others were sometimes only discussed in the classroom. Certain teachers reported opening their laboratory equipment once they began fieldwork teaching and “not knowing what some of it was” or “not knowing what went with what.”

Pacing. Teachers agreed that the issue with pacing is “not the course structure, but the need to remediate students in basic mathematics in order to proceed into the most basic physics concepts we are teaching.” As noted in the *Findings* section, screening for student assignment to the PSI Physics course is sometimes lacking, with reports of students who did not even pass the eighth-grade GEPA or received very low GEPA scores being enrolled in the course. In instances such as these, reviews of basic mathematical fundamentals such as division, multiplication and even subtraction are required in classes containing poorly prepared students.

Teachers are sometimes left with the dilemma of having to choose whether to “leave some children behind” or to remediate them and not challenge other students to the extent they can achieve. One teacher shared that “I enjoy teaching PSI, but our students are not ready mathematically for the course. We spent all of 1st cycle on Kinematics, and all of 2nd cycle on Dynamics, because they did not have the mathematics skills.” Another wrote: “The students learned a lot, but the going was sloooow.”

Technology. The teachers were comfortable with the PSI technology in general, the interactive white board in particular, and to about the same degree with the student response system – although they do not use the student response system as frequently as intended by the PSI curriculum. As stated in the *Findings* section of this report, PSI classrooms are technology-based, but not technology-driven. The multiple technologies are used to benefit the instruction and to measure student learning, and the teacher is the driver of that instruction and assessment. As a result, very diverse teaching styles were observed in the classrooms, belying any concerns some might have had about the teachers being over reliant on the technology and using the notebook lessons in a cookbook fashion.

For example, PSI teachers are free to – and sometimes do – change the order of certain portions of the PSI curriculum. Some also delete and replace those that they believe are either not as effective with a particular group of students (e.g., English language learners or students with special needs)¹⁷ or not in sync with or supportive of their teaching methods or styles. There exists a plethora of supplementary curricular and other resources accessible through the PSI website or on the Web that can be uploaded directly to teachers’ computers in order to project images on SMART™ Boards.

¹⁷ Original content and graphics may be retained for other classes.

Some teachers tend to ‘control’ the interactive white board, with the students having very little interaction with it, while others have students using it to varying degrees, from occasional demonstrations to routine use when working through formulae. Both practices appear equally effective, as classroom observations found student responsiveness, participation and learning to be evident regardless.

Classroom Visits. The visits by the Kean University adjunct professor undertaken in support of certified fieldwork for university credit have been extremely well received, and reported to be valuable in terms of resolving both curriculum and technology issues. Visits from other NJCTL staff are not regularly scheduled, but are as frequent as necessary when there are school or district issues or common questions among several teachers that need to be addressed. Teachers were most appreciated of the “quick response” they received from NJCTL whenever they needed assistance.

Classroom Management. Classroom environments have been conducive to learning in every classroom observed for the Alumni Study, as well as during N&A’s previous evaluations of PSI. Although this is not part of PSI training, it most likely reflects the fact that these are seasoned teachers – a criterion for their selection into the program.¹⁸

Quality of PSI Training.

The alumni gave very high ratings to the PSI training they received, reporting that the goals of the courses were attainable, and that the multiple technologies, examples used in instruction, and course activities were supportive of their learning. One alumna who teaches non-science courses in addition to those for PSI wrote that “I have been applying a lot of PSI strategies to both my Eng IV and SAT preparation classes,” adding that “there are few resources that cannot be uploaded to an interactive whiteboard for any topic.”

Alumni Teaching Satisfaction

The alumni reported that they enjoy teaching PSI courses “more than I thought I would.” As stated in the Findings section of this report, this was an important finding, given that the physical setting of PSI classrooms and the instructional components of the PSI curricula were all new to almost all of the alumni – e.g., small, round tables as opposed to desks, the extensive use of small group work around those tables, the fostering of social constructivism, the absence of a static text book, the delivery mode of interactive technologies, and so forth. Further, although most had STEM backgrounds, many were teaching subjects that they had not taught previously. The fact that they are enjoying teaching to such an extent speaks well of both their motivation and CLT’s effectiveness in delivering the program.

¹⁸ It has been the experience of the N&A evaluation staff that our presence while observing a classroom rarely turns disruptive students into orderly students. To the contrary, they often “act out” to show off or to try to get their teachers negative evaluations.

Interaction with and Support from Other Teachers

As might be expected, there is a good deal of interaction among PSI teachers within their own schools, where they plan together to strategize how they might modify lessons, discuss supplementary materials that might be used, and share challenges, solutions and successes. This is typically carried out before or after school, except in those relatively rare cases where teachers have the same planning periods. Such dialogues are carried out to a lesser extent with PSI teachers in other schools and districts and non-PSI science (and occasionally mathematics) teachers in their own schools.

One teacher wrote that since she and other teachers at her school have become part of “the PSI initiated,” it is the first time that she has “felt comfortable sharing ideas and struggles with other teachers” and is “not afraid of trying something new.” One interviewee spoke of “open-doors” in the science department, continuing with: “We did not share in the past, but now we can’t wait to work together or have other teachers observe our classes and give us feedback.” Because of the obvious and important relationship between PSI’s algebra-based physics course and algebra, some site visit interviewees specified that “the openness among PSI teachers includes mathematics teachers as well.”¹⁹

As discussed previously, PSI-trained teachers who teach courses other than those in the current PSI family of science courses attest to the value of the PSI approach when they upload materials for their courses in earth systems, environmental science, forensic science, and so forth. Perhaps somewhat unexpected is the extent to which the PSI teachers interact about the PSI technology and other approaches with *non*-science teachers within their schools. Teachers in non-science (and non-mathematics) fields find no shortage of resources available to them as well.

School department chairs and principals pointed out that, PSI teachers have inspired other teachers to use PSI technology and techniques. In fact, PSI teachers are in the forefront of training efforts for other teachers in some of the PSI schools, either formally in those with more-or-less school-wide implementation of PSI approaches, or less formally in others. Some principals spoken to during this study and during the course of N&A’s PSI evaluations over the last three years refer to the PSI approach as “*CTL principles*”.²⁰

Student Enrollment, AP Interest and Performance

The 57 alumni respondents who provided classroom data were teaching 2,758 students in PSI classes during spring 2012, with 2,115 of them in the various levels of PSI Physics. All of the students received passing grades in their PSI courses, with 97 percent receiving a “C” or better. Nearly two-thirds of the teachers (64%) reported student interest in taking Advanced

¹⁹ Several of the PSI schools have adopted CTL’s Progressive Mathematics Initiative (PMI) as well.

²⁰ Teachers who are in fields other than science and mathematics tend to use the CTL (Center for Teaching and Learning) acronym rather than PSI or PMI.

Placement classes. This included a very large range from a very limited number in a few teachers' classes to more than half in a small number of others. Overall, 25 percent of the students were reportedly planning to do so.

According to the teachers, student grades could have been much higher than they were (A's = 8% and B's = 52%) had there been more careful screening of students for their PSI courses. As discussed previously, there were students in classes where rudimentary topics such as subtraction, multiplication and division had to be taught (not simply reviewed) in order to begin teaching about physics. There were also classes with students with special needs, which some teachers claimed reduced their effectiveness for the entire class. Conversely, teachers in other classrooms containing students with learning disabilities were able to work effectively to help those students so everyone in the classroom was able to achieve to the best of their abilities.

Student performance is also impacted by absences and tardiness, conditions that are widespread at some schools. Many of the teachers interviewed during site visits provide early-morning, lunch break and after-school tutoring to those students needing more individual assistance, including those with absenteeism or lateness issues. They often provide incentives such as snacks and sodas, but report that "of course, those most in need rarely show up." One said that "even snacks, soft drinks and pizzas don't seem to attract them."

Commentary

Dealing with students who do not do their homework assignments has been an ongoing situation for many teachers. Instructional scaffolding is inherent in science and mathematics subjects generally, and perhaps even more so in the PSI system, which is predicated on the students' need to demonstrate mastery in a topic before proceeding on to the next one. Therefore, if students do not complete their homework in order to review and solidify concepts before the class moves on the next day, it presents a considerable instructional challenge.

3. **Although not grading homework is a tenet of the PSI approach, if certain teachers are having difficulty guiding the students' learning because they are not doing their homework, the program might consider giving them the flexibility to step "outside" the PSI philosophy and collect and grade those assignments until it becomes unnecessary to do so. If homework is essential to learning in a PSI course, perhaps if homework were graded, the students would do it.**

Alumni Support from NJCTL

Rarely was anything approaching negative heard about NJCTL in general or any of its PSI staff members or Kean adjunct professors in particular. On the other hand, words such as "outstanding" and "supportive" were commonplace. So too were comments such as "The people

from NJCTL are always there to help resolve any issues” and “I received support whenever I asked.” There were many more kudos related to the quality of the training, the quality of the website, the quality of the professors and the resourcefulness of the NJCTL staff.

Regardless of the above positive comments, there were other teachers who reported feeling “distant” from the program and “out of touch” with any changes or new advances in the curriculum or technology. It might therefore be beneficial to the program in several ways if NJCTL could seek out these “older” PSI alumni who have been gradually drifting away from their PSI connections to the program staff and other teachers, although they continue to assiduously teach the subjects.

Some of the teachers who were in the program three and even just two years ago are beginning to feel a bit of a “disconnect” with the program– in terms of interactions with the Virtual PLC, alerts to new resources that can be uploaded from the Web and from the NJCTL website, new SMART Board™ techniques, obtaining help with conducting laboratories, and so forth. Despite exhortations from NJCTL staff to the contrary when they complete their PSI training, some of the alumni are reluctant to continue to rely upon or “bother” NJCTL staff. In essence, they shortchange themselves as well as others who no longer benefit from their ideas and inputs – and questions.

When teachers are out of touch with new curricular additions, modifications and technological advancements to the program, their students are penalized as well. ***The following paragraph, which was written on an Alumni Survey in June of 2012, is an extreme example of what can happen:***

*My computer has not been working since about **November 2011**. The SMART Board has not been functioning properly since **September**. I do not know whether it works now as the computer is not working. [Emphasis added.]*

This is a shocking, extremely serious, and heretofore unheard-of situation. Still, it presents an outlier example that gives credence to the need to stay more in touch with more alumni, as this person obviously knew this was not a good situation, and seemed to care – or else s/he would not have completed the survey and taken the time to write about it. In a follow-up telephone conversation with that person, it was found that s/he wasn’t sure who to call – or if it was even appropriate to call – because of being away from the program for some time. Therefore, the students in this class were without some of the extremely important benefits of PSI (an interactive white board and a computer) for an entire school year – the nine months from September through June.

Commentary

The PSI program’s curriculum, assessment methods, resources, and laboratory procedures continue to evolve and expand through the recurrent inputs and exchanges of its virtual professional learning community. However, the longer PSI teachers are away from the formal training program, the more likely they are to begin losing their connection with the PSI

community and its continuous learning and motivational potential. Many remain in contact, but there is a small but notable cluster of others who do not. The latter are the ones who were unaware of recent PSI updates and happenings when interviewed, and regretted having “lost touch” with the program.

Current NJCTL staffing levels are not adequate to continue to provide the same level of support that these teachers received during their formal fieldwork and immediately thereafter, but the need remains to have more engagement than at present. This might be best addressed by the following:

4. **Adding at least one full-time-equivalent staff member to specifically remain in contact with alumni through periodic (and to some extent, on-call) visits to share new ideas, deal with any issues that have arisen, and stress the program’s ongoing commitment to their continued success.²¹**
5. **Conducting “refresher” or “update” mini-workshops on new topics, changes and insights, and reviews of areas where the alumni have felt their knowledge and skills lacking – e.g., laboratories and demonstrations. Additional staffing roughly equivalent to one-quarter to one-half time would be required for arranging and delivering these mini-workshops, and could be added to the supplementary personnel required to implement #4, above – remaining in closer contact with more program alumni.**
6. **In addition to alumni, the workshops might also include some teachers currently taking the NJCTL courses to promote a two-way of exchange around questions such as “What should I know that I don’t know now?” asked by the teachers currently taking courses to the seasoned PSI teachers, and “What are you learning that I didn’t?” from the seasoned to the new. Such interactions will not only serve to update, re-engage and strengthen connections to the program among prior participants, but also create new linkages between those in training and the program’s alumni.**

Alumni Support from Schools and Districts

The concluding section of the previous chapter contained several quotations from teachers regarding the levels and types of support they were receiving – or not receiving – from their schools and districts. There is far from unanimity among those comments, which could be categorized as ranging from “overwhelmingly supportive to “almost hostile.” Some schools were not only positive about PSI itself, but had encouraged other teachers in other non-science subjects to adopt its methods and purchased the SMART™ technologies to support the efforts of those teachers. Of course, this could not have been possible without at least tacit support from their districts, although it might not have been perceived as such by some teachers. Districts

²¹ This would not preclude or supplant other NJCTL staff members’ interactions with alumni, and in some cases the liaison would act as a “referral agent” by putting the person with the most expertise and/or experience with a particular situation in touch with the alumnus requesting assistance.

also financially supported teachers' participation in the PSI program, and purchased the SMART™ technologies and laboratory equipment for their classroom.

Districts and schools have been mostly supportive in not requiring teachers to prepare standard lesson plans, recognizing that the detailed, lesson-by-lesson detail in PSI's written curriculum is more than sufficient. One notable exception among the schools visited in this study was a "turnaround" school with a new evaluation system that requires that lesson plans be a part of a multi-focused evaluation system.

School issues that might seem mundane to "outsiders," such as a lack of certain basic resources – e.g., working copy machines, copy paper, classroom supplies, etc. – were a recurrent issue during site visits, but given current education budgets, these are not situations unique to PSI teachers, with the exception of laboratory equipment, which while important, is not as critical as some other concerns.

Commentary

Teacher reports of – and concurring evaluator observations of – students who do not have "basic mathematics skills" in their classes presents a huge challenge for teachers and is a detriment to learning for more capable students. This does not necessarily refer to students with special needs, as N&A evaluators from the very beginning have been duly impressed with the ability of many PSI teachers without backgrounds in special education to successfully integrate these students into their learning activities.

There are also situations in which the program has a supportive principal but an unsupportive science department chair – or *vice-versa*. This puts teachers in untenable positions, especially in those instances where there may only be one or two of them in a school. It is obvious to an outside observer when there is such conflict, because teachers are nervous while being observed and are reluctant to say much in interviews, because they believe *they* are being evaluated instead of the program. In interviews with unsupportive school personnel, their lack of support averseness was typically found to be the result of basic philosophical differences with the program, a lack of understanding of the reasoning and/or research behind certain tenets of the program, or even personalities or school/district politics.

Department chairs, science supervisors and principals are welcoming of PSI's use of SMART™ technology. What is most troublesome to those who are not fully supportive are what they term the "untraditional" elements PSI –not preparing "customary" lesson plans, using only one mode of assessment (quizzes and tests, to the exclusion of portfolios and projects), students being able to re-take tests until they pass them, and the fact that homework is not graded. Since PSI cannot be thrust upon people or systems, these people certainly were told of the reasoning and research behind PSI at some point, or the program would not be in their schools. However, they may need to be reminded.

7. **The preparation of a concise summary of or “talking points” about PSI’s philosophy and approaches, with references to the research behind it could be beneficial to obtaining and continuing the support of those in positions to impact PSI favorably or negatively. The need for students’ prerequisite knowledge for PSI courses would be an important component of this document. It would be especially helpful in informing personnel in new districts and schools and “re-informing” others where the program is continuing. The document would also be valuable in instances where principal turnover results in either a lack of knowledge about or a negative change in support for the program.²²**
8. **Every effort needs to continue to be made to ensure that there is judicious screening of students enrolling in PSI courses, for the benefit of all students in those classes. Not doing so negatively affects all students in a class.**

²² One teacher reported having two principals in two years; another, three principals in two years.

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