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ABSTRACT

This study evaluated a science professional development initiative developed by the Delaware State Department of Education, examining the nature of professional development activities, their effect on science classrooms, and their impact on teachers, students, and schools. The Science Van Project integrated technology and inquiry into Delaware's high school classrooms. Science Van visits consisted of a specialist who brought sets of laptop computers interfaced with electronic data-collecting probes or other hardware/equipment to teachers' classrooms. A typical classroom visit lasted 4-8 days. Specialists worked alongside teachers to demonstrate the proper use of technology and to model best practice pedagogy. Students used the technology to conduct scientific investigation. To be eligible for Science Van visits, teachers had to participate in project workshops. Data from surveys, interviews, observations, and pretests/posttests of teachers and students indicated that the project effectively incorporated the five elements of professional development. Teachers reported increases in areas specifically targeted by the professional development and in their knowledge of state content standards. They gave the Science Van program high ratings in effectiveness. Students reported liking the Science Van visits very much. They believed that their understanding of science content and of designing and conducting experiments improved. (Contains 13 references.) (SM)

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TRAVELING ROAD SHOW OR EFFECTIVE PROFESSIONAL DEVELOPMENT?: A Professional Development Science Project on Wheels

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Traveling Road Show or Effective Professional Development?: A Professional Development Science Project on Wheels

"I would have never done it without the Science Van training. I'm really trying to incorporate inquiry-based learning in my classroom" (10th Grade Biology Teacher, 1999)

Introduction

Science education is one of the six national priorities set by educational and political leaders to prepare the United States to face the economic, political, and technological challenges of the 21st century (Yager, 1993). Consequently, the task of reforming science teacher education and the teaching of science in America's classrooms are challenges facing both colleges of education and school districts. This challenge becomes even more critical in light of the results from the Third International Mathematics and Science Study (Office of Educational Research and Improvement, 1998), the National Science Education Standards (National Research Council, 1996) and Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993), as well state science standards like those in Delaware (State of Delaware Science Curriculum Framework--Content Standards, 1995/1996).

Over the past decade there have been great demands and initiatives for school reform in the teaching of the sciences, but there remains a paucity of methods for equipping educators with the skills and knowledge they need to effect school reform. If professional development programs are to improve learning for teachers, and consequently for students, they must be effectively designed and implemented. Indeed, the core technology of schools (teaching and learning) will not change unless staff development is of high quality, relevant, and sustained in nature.

Schools have long neglected the systematic professional development of teachers, staff, and administrators. More often than not, efforts to improve schools have dealt with professional development on a hit-or-miss basis. Professional development has suffered because of its separation from other critical elements of the education system with the result that new ideas and strategies are not implemented. One-day workshops come and go, with virtually no impact on teaching and/or learning. As noted by Loucks-Horsley (1999),

> ...the professional development...experience is typically weak, limited, and fragmented, incapable of supporting [teachers] as they carry the weight of adequately preparing future citizens. Programs fall far short of helping teachers develop the depth of understanding science content they must have, as well as how best to help their students learn it. (p.2)

The purpose of this study was to evaluate a science professional development initiative developed by the Delaware State Department of Education. In addition to an evaluation of stated project goals, the State Department of Education was particularly interested in the effect that this professional development had on student achievement, long considered the "black box" of professional development. Findings are reported regarding the nature of the professional development activities, their effect on science classrooms, and their impact on teachers, students, and schools in Delaware.

Project Description

In June 1995, the Delaware State Board of Education approved the <u>Science Curriculum Framework--Content Standards</u> for students in grades K-12. The Science Standards represented two and one-half years of collaboration involving science teachers, school administrators, university professors, and business leaders. This collaboration was aimed at the establishment of rigorous content and performance standards for all students.

The existing state of secondary science education in Delaware at the completion of the Science Standards could best be described as "textbook driven" (Danin, 1997). Throughout the state there were numerous examples of excellent teaching and learning that impacted some students; however, there was no systemic effort to improve science teaching and consequently, the achievement of all students. The Science Van Project (Science in Motion) was conceived to promote science education in which all high school students in this predominantly rural state could be engaged in standards-based systemic reform. The Project is designed loosely on a van project out of Juniata College in Pennsylvania. This reform effort necessitated changes in content emphasis, a shift to inquiry-based learning anchored in real-world contexts and current technology, a better understanding of how students construct and use knowledge, and more authentic assessment.

The Delaware Department of Education, in collaboration with the Delaware Science, Math, and Technology Education Foundation (representing the business community), established a professional development project aimed at integrating technology and inquiry into Delaware's high school classrooms. A commitment was obtained from the state legislature and the Foundation to provide funding for office facilities and all the equipment necessary to subsidize two full-time secondary science specialists. These science specialists (master teachers) would work in the field to assist teachers and students in meeting the Science Content Standards and Performance Indicators by providing sustained professional development for teachers, modern

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scientific equipment and technology for the classrooms, and exciting inquiry-based, problem-solving activities for students. The Delaware Science Van Project (Science in Motion) established its mission as "assisting public high schools in meeting the high aspiration of the Science Content Standards by providing modern scientific equipment and professional development that promote student involvement in exciting inquiry-based, problem-solving activities" (Website, p.1).

In summer 1996 and winter 1997, the Department of Education hired two award-winning high school science teachers, who were respected throughout the state, to serve as the Science Van Education Specialists. The Project Director is the Former State Supervisor for Science Education. From the very beginning, their mission was to combine technology and inquiry to support the Delaware Science Standards.

The Project began with a focus on computer-interfaced data collection, so the first year the Science Van Specialists along with content specialists designed the biology activities, followed by chemistry and physical science by the end of the second year of project implementation. Computer/probe technology was the main emphasis, but they added gas chromatography and have recently begun extensive work with gel electrophoresis. It is notable that the two Specialists had never used a computer interfaced with a data collection probe prior to the Project and that most of their skills for using the technology have been acquired from on-the-job learning.

In addition to the development of computer infused activities in the summer and fall 1996, the Project obtained funding from the Delaware Science, Mathematics, and Technology Foundation for equipment and materials. This funding enabled the purchase of 18 computers, probes, chemicals, beakers, and materials and supplies to create two

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self-sufficient (except water, lab benches, outlets, and safety equipment) laboratory programs capable of traveling to school classrooms. A laboratory was also equipped at the Project Headquarters, the Science Resource Center, which serves as a resource for preparing equipment and materials for road trips and for developing new inquiry activities.

One Science Van Specialist works in the northern half of the state, while the other works in the southern portion. They conducted their first workshop in February 1997 with the first Van visit to classrooms in March. Since that time, the two Science Van Specialists have worked with at least 75 different teachers, reaching close to 15,000 students in over 600 different classrooms.

The Science Van visits consists of a Specialist who brings sets of laptop computers interfaced with electronic data-collecting probes or other hardware/equipment to a teacher's classroom. A typical classroom visit lasts from four to eight days. In addition to bringing materials and equipment, the Project Specialists work alongside the teachers in their individual classes demonstrating the proper use of technology and modeling methods of best-practice pedagogy. Students, working in small groups, are able to use the technology to conduct scientific investigations.

To be eligible for a visit from the Science Van, teachers must first participate in a project workshop, which is typically offered on weekends and in the summer. Any high school science teacher may elect to participate in a workshop--attendance is voluntary and individual school districts may use Title II funds or other sources for workshop registration fees. To date, nearly 200 different science teachers, representing 29 of 30 high schools in Delaware have voluntarily participated in weekend, summer, or school-

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site workshops. This represents an overwhelming majority of high school science teachers in Delaware.

An exciting outgrowth of this project has been the establishment of "clone" labs in over half of Delaware's high schools. Six high schools were able to secure grant money to purchase rudimentary class sets of computers and probes. Delaware's Department of Education, working in collaboration with the Delaware Science, Math, and technology Education Foundation and Kick-Start (an AmeriCorps program), was able to award grants or starter probe labs to 10 additional high schools. Eligibility for grant awards was based partly on the individual school's intent to pursue continued professional development and ability to secure matching financial support.

In September 1998 the Project Director and Science Van Specialists requested funding from the Delaware Department of Education to conduct a formal evaluation of the Science Van Project.

Related Literature

Research has shown that professional development programs need certain elements to facilitate new ways of teacher and student learning and improved student achievement. As noted in the Delaware Statewide System for Professional Development (1998), "effective professional development programs are standards-based and results-driven: increasing the knowledge and skills of educators will impact the learning of students" (p.13).

Knowledge from research, theory, and the "wisdom" of experienced, practicing professional developers suggest five principles of effective development:

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- Professional development experiences must have students and their learning at the core,
- Excellent science teachers have a special and unique knowledge base that must be developed through their professional development learning experiences,
- Principles that guide the improvement of student learning should also guide professional learning for teachers (including active learning, focusing on fewer ideas more deeply, and learning collaboratively),
- The content of professional learning must come from both inside and outside the learner and from both research and practice, and
- Professional development must both align with and support system-based changes that promote student learning (excerpted from Loucks-Horsley, Hewson, Love, & Stiles, 1998).

These characteristics of effective professional development provide a means to assess the quality of efforts by the Delaware Science Van Project. They incorporate a growing body of research, not only in professional development, but also in adult learning theory, shared leadership, effective schools, and the change process (see Darling-Hammond & McLaughlin, 1995; Fullan, 1993; Lieberman & Miller, 1992).

Methodology

In order to evaluate the degree of attainment of project goals a mixed methodology (see Tashakkori & Teddlie, 1998) was employed. We were not only interested in students' and teachers' attitudes toward the use of technology and inquiry-based pedagogical practices in the classroom, but also concerned about the effects of this

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professional development project on student achievement. The evaluation, thus, attempted to trace the thread that runs from teacher professional development to student achievement. Data were collected to assess the quality of professional development, project implementation, and student impact.

Data collection in the field lasted from January 1999 to May 1999. Surveys, interview, observation protocols, and pre/post-tests were designed. The teacher survey was mailed to all high school science teachers in Delaware and focused on four areas: (1) background information (certification, degree, years experience, professional development involvement, etc.); (2) information about pedagogical practices, the Delaware State Science Content Standards, and the use of technology in the classroom; (3) the impact of the Science Van Project, and (4) open-ended responses for teachers' anecdotal evidence related to student achievement, project expansion, and change. A second teacher survey was administered to those who attended the professional development workshops and experienced van visits to their classrooms. Lastly, students in the science classrooms visited by this project completed surveys. All three surveys contained Likert-type responses as well as open-ended questions.

The semi-structured interview protocols were designed to help assess project implementation and effect. Interviews were conducted with randomly selected teachers, students, and the two Science Van Specialists. Teachers were asked about changes in their teaching due to this project's professional development, challenges faced in requiring students to be actively engaged in the learning process, and other positive, as well as negative, effects of this project on their teaching and students. Students were asked to describe the inquiry-based methods utilized by their teachers, and about their

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perceptions of the Science Van Project. Lastly, the Science Van Specialists were interviewed regarding the project, their responsibilities, and their perceptions of project strengths and weaknesses.

In our efforts to determine the effect of this professional development project on student achievement, multiple-choice tests were designed with the assistance of the Science Van Specialists and administered in pre-and post-test fashion. Pre-tests were administered prior to the Van visits; followed approximately 10 days later by post-testing. Test items were designed to capture both student content and process knowledge. Statistical testing involved t-tests for dependent samples. Although more authentic assessment would have been ideal, this option was not feasible due to time and monetary constraints.

Lastly, observations were conducted in science classrooms and at professional development workshops. An observation protocol was developed that allowed data to be collected in the following areas: (1) background information, (2) classroom demographics, (3) the physical environment of the classroom, (4) description of student activity, (5) instructional materials, (6) the purpose of the lesson observed, (7) classroom climate, and (8) likely impact on students.

Sampling techniques were appropriate to the data being collected—with both purposive and random sampling utilized. Likert-type numerical responses to the surveys were analyzed using frequency distributions and means. Finally, open-ended responses were analyzed through the clustering of teachers' and students' responses into themes or categories. Table 1 provides more detail regarding the purposes, methods, and sources of data collected.

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Table 1: Data Collection Purposes, Methods, and Sources

DATA COLLECTION PURPOSE	METHOD	DATA SOURCE
1. Quality of Professional Development	Survey (Likert and open-ended questions)	85 Teachers representing 15 school districts
	Survey of Professional Development Workshops (Likert and open-ended questions)	36 Teachers
2. Implementation	Survey of Van Visits to High School Classrooms (Likert and open-ended questions)	24 Teachers 116 Students
	Classroom Observations (Observation protocol)	6 Classrooms
	Interviews (Semi-structured interview protocol)	16 Teachers 31 Students 2 Van Specialists
3. Student Impact	Pre/Post-tests of Student's Content and Process Knowledge (15 question multiple-choice test)	294 Students

Findings

From the data collected the evaluation concluded that the Delaware Science Van Project has effectively incorporated the five elements of professional development (see literature review). More specifically, the Project used the following strategies to insure the delivery of effective professional development.

Strategy #1: Professional development experiences must have student and their learning at their core.

Immersion into inquiry science and immersion into the world of science are core qualities of this professional development model. Many teachers have had little opportunity to engage in scientific inquiry in their preservice programs. In the Science Van Project, teachers are engaged in the kinds of learning that they in turn are expected

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to practice with their students. Assuming the role of students, teachers collaboratively conduct experiments, report on their findings, and critique the process. By becoming learners, teachers deepen their own understanding of the science content they will teach and become better prepared to assist student in becoming active, engaged inquirers. By "becoming scientists" in a research environment, teachers deepen both content and pedagogical knowledge, developing skills in sharing and critiquing scientific information with other professionals.

Strategy #2: Excellent science teachers have a very special and unique knowledge that must be developed through their professional learning experiences

Curriculum development and adaptation are viewed as effective strategies for professional development. Teachers learn exactly what they need to teach. To insure the effectiveness of this strategy, numerous and varied opportunities were provided for teachers to learn from the Science Van Specialists, university professors, and from other teachers. From these varied opportunities high quality, replacement units were developed. These units reflect the important science concepts that are recommended by both state and national science standards. Using curriculum implementation as a vehicle for professional development combines two major parts of the system—curriculum and teaching; so changing one part will change the other. Replacement units have been developed for Biology, Chemistry, Physics, Physical Science, Earth Science, and Physiology. Examples include: Energy in Food, Investigating Diffusion through Membranes, Reflectivity of Light, Investigating Pulleys, Investigating Breathing and Human Heart Rates, and Antacid Titration.

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Strategy # 3: Principles that guide the improvement of student learning should also guide professional learning for teachers.

The closer professional development brings teachers to student learning the better. Engaging in active learning, focusing on fewer concepts more completely, and learning collaboratively are characteristics of this professional development. Additionally, examining student work focuses teachers' attention on the consequences and effectiveness of their teaching and highlights discrepancies between what teachers believed they were teaching and what students appear to have learned.

Strategy # 4: The content of professional learning must come from both inside and outside the learner and from both research and practice.

The Science Van model also utilizes the coaching and mentoring of teachers and partnerships with business, industry, and universities. Coaching and mentoring are professional development strategies that provide one-on-one learning opportunities for teachers. These activities occur when the Science Van Specialists visit a classroom and work side-by-side with teachers for six hours a day modeling and co-teaching and working with students. Teachers who have been actively involved in this Project and who have developed replacement curriculum units also provide coaching and mentoring opportunities.

Strategy # 5: Professional development must align with and support system-based changes that promote student learning.

Lastly, the Science Van model aligns with and supports system-based changes that promote student learning. Through workshops, university courses, and classroom visits teachers are afforded multiple opportunities to learn, practice, and reinforce new

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teaching methods and behaviors. This professional development model also promotes the development of professional developers from the ranks of teachers. Networking of teachers affords the development of school-university collaborations, teacher-to-teacher, and school-to-school linkages.

To date, nearly 200 science teachers have participated in weekend, summer, and school-site workshops. In an attempt to assess the effect of the Science in Motion Project on teaching 61 teachers responded to the survey summarized in Table 2.

Table 2: Effects of Project on Teaching (n=61 ratings ranged from a low of 1 to a high score of 3)

Teacher Survey Item	Mean
1. How would you rate your knowledge of Delaware's science content standards **prior** to your involvement with the Science in Motion Project?	2.31
2. How would you rate your knowledge of Delaware's science content standards **after** involvement with the Science in Motion Project?	2.51
3. How would you rate your ability to incorporate modern scientific equipment into your lessons **prior** to the Science in motion Project?	1.28
4. How would you rate your ability to incorporate modern scientific equipment into your classroom **after** involvement with the Science in Motion Project?	2.25
5. To what extent did you incorporate inquiry-based teaching methods into your classes **prior** to exposure to the Science in Motion Project?	2.05
6. To what extent do you incorporate inquiry-based teaching methods into your classes **after** exposure to the Science in Motion Project?	2.95
7. Do you see any connection between your professional development and changes in your teaching of science?	2.99

All pre and post comparison scores increased. The overall differences were significant at the .05 level of probability. Of particular note is that teachers not only reported increases in areas specifically targeted by the professional development such as improved ability to incorporate modern scientific equipment and improved use of inquiry-based teaching, they also reported a slight increase in their knowledge of the state's content standards.

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Typical teacher comments regarding the professional development opportunities included:

> *The techniques and concepts they discuss during the lab activities enrich the teacher's knowledge.*

> *After being involved in the Project's workshops, I feel I developed the skills that allowed me to be better at getting students to use more of their higher order thinking skills.*

> *Teachers have become strongly engaged in the professional development as they see this as a way to engage more students in their classrooms.*

> *The Van Project has given me new ideas by which to engage students in the process of learning. This has been the most rewarding and useful professional development I have ever had.*

When asked to compare their ability to incorporate modern scientific equipment (vernier data collecting probes, gas chromatographs, computers) before and after professional development, the rating increased from a mean score of 1.28 to 2.25 on a scale of 1 (no knowledge/ no ability) to 3 (very knowledgeable/ very able). In the interviews teacher commented:

> *I feel more comfortable using the equipment.*

> *I have acquired valuable knowledge, skills, and teaching methodology on which I can build. Also, I will be better prepared as computers and scientific equipment become readily available for student use in science laboratories.*

> *My confidence with the equipment, as well as sufficient equipment during the van visits, has improved because if inservices and classroom support.*

Evaluation of Science Van Visits to Classrooms

Data were collected from both teachers and students to assess the impact of the science van visits. When asked to rate the overall value of the Van visit to their classroom, using a scale of 1 (no value) to 5 (very valuable), students responded with a mean score of 4.03 (see Table 3). When asked what they like most about the Van visit, students answered:

The fact that we could work one-on-one with the computers instead of watching a teacher just showing us.

It helped me understand science better.

The idea of using high-tech equipment to gather data rather than using conventional methods.

Table 3: Student Evaluation of Van Visits (n=116 students)

Survey Item	**Scale** 1 → 5	**Mean**
1. Rate how well you were prepared by your teacher for the Van visit	Poorly Prepared------Well Prepared	4.07
2. Rate your comfort level with computers before the Van visit	Uncomfortable---------Comfortable	4.03
3. Rate your comfort level with computers after the Van visit	Uncomfortable---------Comfortable	4.32
4. Rate how helpful the Van teacher was in assisting you	Not helpful-------------Very Helpful	3.90
5. Rate how your understanding of the science topic improved as a result of the Van visit	No Improvement--Improved A Lot	3.80
6. Rate how your understanding of how to design and conduct an experiment improved as a result of the Van visit	No Improvement--Improved A Lot	3.81
7. Rate the overall value of the Van visit to your classroom	No Value-------------Very Valuable	4.03

All mean scores placed on the positive end of the scale. Students reported being well-prepared for the visit, more comfortable with computers after the visit, believed their understanding of the science content improved, and their understanding of designing and conducting an experiment improved.

Teachers also responded to surveys that inquired about the impact of the van visits to their classrooms (see Table 4).

Table 4: Teacher Evaluation of Van Visits (n=23 teachers)

Survey Item	Mean 1 → 5
1. How well did the Van workshop experiences prepare you for the Van visit to your classroom?	4.69
2. How well did the Science Van Specialists communicate to you prior to the classroom visit about the student activity and what would happen in your classroom?	4.65
3. Rate your comfort level with using computers and probes prior to the Van visit.	3.83
4. Rate your comfort level with using computers and probes after the Van visit.	4.52
5. Rate how well the Introduction of the activity provided your students with background knowledge and computer/probe skills	4.39
6. Rate how well the Student Designed Investigation provided your students with problem solving, inquiry skills.	4.48
7. Rate how well the activity assisted you in implementing Delaware Science Content Standards	3.57
8. Rate how comfortable you were with the team teaching relationship with the Science Van Specialists	4.91
9. Rate the value of the Van visit to your professional development.	4.87
10. Rate the overall value of the Van visit to you and your students.	4.78

All mean scores fell on the high positive end of the scale.

Impact on Students and Schools

When asked to discuss the project's effect on student achievement teachers offered the following anecdotal evidence:

> *Students were able to transfer concepts from lab situations to situations outside the lab--their interest in science has increased.*
>
> *Graded projects showed that students could take data and draw logical conclusions.*
>
> *Test scores have improved on topics covered by the Van Project, especially in low-performing students.*
>
> *I feel with increased student interest comes increased retention of the subject matter and increased achievement would just naturally flow.*
>
> *The additional hands-on and high tech lab infusion has helped retention and understanding of the scientific method.*

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I have seen an increase in grades during the marking periods that we had van visits. In addition, the only test which I have given before and after a computer inquiry project has shown a great improvement in scores.

Mindful of the need to link the professional development initiatives to student achievement, pre and post-tests were administered. The results of the dependent t-tests are presented in Table 5 for four of these units: Diffusion through Membranes, Passive Solar, Acid-Base Titration, and Freeze-Melt.

Table 5: Pre- and Post-Tests Results (a total of 15 questions equal to 15 points on each test)

TEST	# of Students	Pre-test	Post-test	SD	Probability
Diffusion	104	6.0	9.6	3.3	>.005
Solar	64	5.6	11.6	3.1	>.005
Acid-Base	34	8.3	10.5	2.2	>.005
Freeze-Melt	92	9.9	11.6	2.0	>.005

The impact of this project on the high schools in Delaware has been significant. Presently there are 16 schools that have "cloned" the project. "Cloning" involves individual schools obtaining the funds to purchase the equipment and materials that are available during the Science Van visit. Science teachers, then, are no longer as dependent upon van visits and can experiment more frequently with providing their students with inquiry-based instruction.

Concluding Discussion

Research on teachers and pedagogical reform reveals that one-time workshops or inservices are unlikely to result in significant, long-term change in practice (Fullan, 1991;

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Little, 1993). To change the way teachers teach multiple opportunities to learn, practice, and reinforce new behaviors must be available. Following the wisdom of this research, the Science Van Project offered its teachers weekend workshops, university courses, mentor relationships, and Science Van Specialists to "guest" and co-teach, modeling the pedagogical strategies desired as a result of the reform. The Science Van Project engages teachers in real-time data collection and analysis and gives them opportunities to foster student achievement in science. The staff development provides the teachers with the skills they need to incorporate inquiry-based, standards-based science curriculum in their classrooms.

Loucks-Horsley (1999) wrote, "A bridge, like professional development, is a critical link between where one is and where one wants to be" (p.2). But she also cautions that "A bridge that works in one place almost never works in another. Each bridge requires careful design that considers its purpose, who will use it, the conditions that exist at its anchor points (beginning, midway, and end), and the resources required to construct it" (p.2). Indeed, many programs have shown substantial success, but that success has proven difficult to replicate. Mindful of this caution, we turn to the lessons that have been learned from this professional development project in hopes that other states or school districts may be able to apply some of these best practices.

<u>Lessons Learned</u>

A number of lessons have been learned from the implementation and evaluation of this professional development project. These "best practices" include:

- The need for more challenging science content for students means that their teachers will also have to learn more challenging science content and how to teach it.
- Effective professional development involves active study, over time, of science content and pedagogy in ways that model effective learning and makes direct connections to teachers' practice.
- The professional developers are faced with the challenges of juggling schedules, dealing with resistant teachers, negotiating with school administrators and the community for resources and support, and staying current in areas of expertise.
- Using curriculum replacement units is a cost-effective approach to providing professional development. But teachers must ultimately make the new content and pedagogical strategies an integral part of their curriculum.
- While some reformers believe that curriculum standards are sufficient to produce high levels of learning for all students, the experience of this project teaches us that high levels of support for teachers is also required.
- Professional development must recognize and plan for progressive stages of teacher learning. These stages include: awareness⇨ preparation⇨ implementation⇨ refinement.
- Teacher training involves not only awareness activities, but also knowledge and skill development and transfer into the classroom. Coaching and mentoring seem to be most effective in facilitating this transfer.

- People learn best through active involvement and through thinking about and verbalizing what they have learned.

Teacher Concerns

To conclude, we would be remiss not to mention the major concerns that teachers expressed regarding this project. Teachers are worried about the time it takes to teach inquiry-base science, the fewer number of units and science concepts that can be covered, and the effect of this on state and national high-stakes testing. When teachers were asked to discuss their concerns about the project the phrases "we need to cover content" and "how will my students perform?" were repeatedly heard. This is one of the points covered in the TIMSS studies, that American teachers cover more topics in less depth and need to cover fewer topics in greater depth if students are to enter the 21^{st} century prepared to face the economic, political, and technological challenges facing them.

Scheduling issues also concerned teachers. Teachers who were teaching in schools that were block scheduled were particularly concerned about time and the fact that students were in a class for only 90 days per school year.

As noted in the introduction, researchers and practitioners largely have failed to establish a direct link between professional development and increased student achievement. The National Staff Development Council (NSDC) noted that 90% of all professional development makes no difference at all. This puts professional development in an awkward position in the educational landscape. While Delaware's science teachers consider professional development essential to their State's educational reform efforts and more research is needed.

In the final analysis, we conclude that the Delaware Science Van Project (Science in Motion) is a well-rounded professional development project that blends inquiry-based pedagogical practices, hands-on activities, teacher mentoring and coaching, technology, the networking of teachers and other science personnel, and continued support of classroom activities by van specialists into an exemplary project. Best practices from research and practice have been effectively employed in the design and implementation of this project. As a chemistry teacher commented, "When you mention to the students that the Science Van is coming, they say 'ALRIGHT.' They get excited...they love it...love the computers and the probes."

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