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Integrating Point-to-Point Videoconferencing Into Professional Development of Rural Elementary School Science Teachers

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Abstract

This study investigated the effectiveness of using point-to-point videoconferencing for a 3-day professional development workshop of elementary school science teachers as part of the Science Co-op Project in rural Missouri. The intentions of this exploratory case study were to provide an overview of the program and to assess the degree to which participating teachers perceived the effective use of distance education technologies to address the challenge of reaching teachers in rural, isolated areas. The sample of teacher participants had participated in at least one traditional, onsite professional development workshop in previous years of the project. An exploratory case study design methodology was used to ascertain new information as it arose during the data collection process. Results suggest that teachers perceived the use of point-to-point videoconferencing to be as effective as their previous experience in traditional workshops. However, teacher participants overwhelmingly preferred to have the workshop leaders onsite.

Distance learning programs are increasingly being explored in many areas of education. In particular, schools in rural settings, which have traditionally been underserved and dislocated from their urban counterparts, are now seeing the benefit of distance learning technologies. It would seem, then, that there should be a natural marriage of rural teacher training, professional development, and distance education.

The perceived benefit distance education brings to students has made it a popular avenue for fulfilling course requirements and, most recently, teacher professional development. Top-down legislation is striving for high student achievement, increased teacher enhancement, and the integration of technology in school curricula. Increased amounts of more effective teacher professional development is critical if the goals set-forth in the latest reform movements are to be accomplished. Through innovative distance delivery, rural teacher professional development has the potential to reach a large audience without losing the critical intangibles of the traditional workshop.

It is critical that teachers are exposed to and feel a sense of comfort with emerging technologies. Teachers need constant professional development with technologies to keep up with the technologically literate students in their classrooms.

Along with the explosion of distance learning technologies, standards-based curricula and high stakes student testing are being promoted as the road to improved student learning and achievement. A rash of legislative actions prompted changes in research and education. The decline of student achievement revealed by the 2000 National Assessment of Educational Progress (NAEP) and the 1995 Third International Mathematics and Science Study (TIMSS) has generated extensive debate about how to find out what is wrong with the schools and how to fix them. Authors of the 1997 report by the U.S. Commission on National Security in the Twenty-First Century suggested that the inadequacies in the current system of research and education pose a greater threat to National security than conventional war (National Defense Panel, 1997).

Improving classroom teaching is a major driving force of legislation as the United States searches for ways to increase student learning (Lampert, 2001; National Commission on Mathematics and Science Teaching for the 21st Century, 2000). On January 8, 2002, President George W. Bush, signed into law the Elementary and Secondary Education Act (ESEA), also known as the *No Child Left Behind Act of 2001* (NCLB), with hopes to ensure educational quality through standards-based curricula. United States Secretary of Education Rod Paige (2002) suggested that technology can expand access to learning and close the educational achievement gap in America. He continued by stating what these new education reforms say loud and clear: One size does not fit all when it comes to educating our children. Innovation and creative thinking are critical to help ensure that every child is educated.

The connection between teaching and learning would support an assertion that if no child is left behind, then no teacher should be left behind either.

Purpose of the Study

The purpose of this study was to evaluate the effectiveness of using point-to-point videoconferencing for the purposes of science teacher professional development for elementary school teachers in rural settings. The sessions lasted 8 hours for each of the 3 days allocated for this workshop. The investigation into the feasibility of integrating point-to-point videoconferencing for professional development and the subsequent affect on teacher participants drove the study.

This study took place in the third year of a 5-year professional development project. Due to unforeseen depleted funding, it was neither cost effective (travel, hotel, per diem, etc.) nor logistically (arrangements, paperwork, etc.) possible to have approximately 100 teachers travel to a single site or to have multiple workshops over 4 weeks. The resulting decision established a central site to which all but 13 of the teachers could travel each day of the workshop. The 13 outlying teachers would have had to drive 90 minutes or more to and from the workshop each of the 3 days. Therefore, point-to-point videoconferencing was integrated into the workshop design to include the remote participants into the general population of the workshop at the central site. The research question thus became, what affect would the integration of point-to-point videoconferencing have on teacher participants in both the central and remote workshops sites?

Setting of the Study

A professional development project targeting teachers in remote, rural school districts provided an opportunity to research alternative forms of distance delivery systems. The *Science Co-op Project* was a National Science Foundation research initiative that focuses on local systemic change in rural school districts in Missouri and Iowa. The *Science Co-op Project* (2000-2005, NSF Grant ESI 9911857) targeted over 1,000 teachers and more than 20,000 students in 38 school districts over approximately 40,000 square miles of land area.

One of the major goals of the project was to enhance the pedagogical content knowledge of the participating teachers through a series of summer workshops, school year support, and distance learning sessions. This study took place during the summer workshop that commenced the fourth year of the 5-year project.

Rural Populations

It is vital that teachers become life-long learners (Craft, 1996). According to Vygotsky (as cited in Glasson & Lalik, 1993), collaboration with other professionals allows for essential learner interactions. Often rural schools are too isolated from other professionals to provide this needed collaboration (Renyi, 1996). Rural school systems are historically underserved not only by their isolation from other teachers but also by their isolation from research institutions (Williams, Gold, & Russell, 1995). Due to this isolation, teachers in rural areas are often out of touch with optimal teaching strategies because they are not able to keep abreast of the most current research (Stephans, 1994). A solution to reaching rural teachers might be the use of distance education technologies.

Rural schools by structure and philosophy match the expectations and description of a learning community. Establishing a learning community in a rural school can create an atmosphere that encourages committed educators to grow through trust, respect, and collegiality (Haar, 2003). In rural Michigan for example, 102 teachers immersed in a professional development experience on constructivist pedagogy expressed the importance of community to overcome the apprehension to their changing pedagogy (Kinnucan-Welsch & Jenlink, 2001). Aram, Breck, and Saunders (2002) suggested that teachers working and planning as teams are more likely to integrate interdisciplinary teaching practices. Further, this dynamic provides for increased student learning (Gosmire & Vondruska, 2001).

The term *underserved* is multifaceted when referring to most rural schools. Not only are these schools geographically isolated, but also in many cases these teachers must cope with poor text, materials and supplies and inadequate classrooms and labs (Lynch,

2000). The larger problem is endemic to the K-12 teaching profession—the isolation of the classroom teacher. Most teachers are isolated and, unlike other professionals, have little access to the resources they need to stay up to date in their fields. In contrast, teachers in other countries are provided far more paid time for planning and professional development: Japanese teachers spend about 40% of their paid time on professional development and collaboration compared with about 14% for their American counterparts (Web Based Education Commission, 2000).

The call for teachers to become "Highly Qualified" is daunting. Accomplishing this goal requires statewide collaboration among higher education, school districts, certification boards, and departments of education. Data from recent studies of teacher recruitment, retention, and professional development in Wyoming illustrates the dilemmas of trying to improve teacher quality in rural states with decreasing populations and resources (Holloway, 2002). Wyoming is only one example of the decreasing population and resource dilemma. A review of recent literature examined the growing shortage of qualified teachers related to rising enrollments and high teacher turnover for rural schools in Oregon, Washington, and Montana (Boss, 2001). For rural schools to succeed, ongoing professional development is crucial. In the Prairie Teachers Project, it was reported that rural schools likely to retain new teachers had ongoing programs of professional development, supportive colleagues and administrators, and stable employment conditions (Harris, 2001).

Professional Development in Local Systemic Change

Bruner (1960) argued that children are ready to learn when teachers are ready to teach. Reynolds (1995) contended that preservice programs at postsecondary institutions are not preparing elementary teachers properly in science content, which ultimately, has adverse effects on their students' understanding and motivation in science. The call is increasing for ongoing, scientifically based professional development. Professional development that reflects teachers' ongoing classroom duties and provides a network of collaboration with other teachers has proven successful in helping teachers become lifelong learners (Hiebert, 1999; Zigmarmi, Betz, & Jennings, 1977).

With the high publicity and the immense impact that the No Child Left Behind Act is having on the educational community, it has become increasingly critical to provide evidence through well-researched programs that teacher professional development is addressing the goals of reform brought on by the Federal government (Slavin, 2002). In the field of science education, teachers must engage in continual professional development throughout their careers, constantly refining their science content knowledge and pedagogy.

The goal of modern teacher professional development is to improve teacher performance and ultimately student performance (Sparks, 1994). In separate Local Systemic Change projects, Supovitz& Turner, 2000, Raghavan, Cohen-Regev, & Strobel (2001) and Calhoun (2002) reported a relationship between the number of hours of professional development and student achievement. If nothing else has been learned from studies on professional development, it seems clear that enhanced student learning cannot take place without enhanced skills and knowledge of the teachers who teach them.

The National Commission on Teaching and America's Future (Darling-Hammond, 1996, premise 1) stated that what teachers know and do has the most important influence on what students learn. For students to learn at high levels teacher educators must prepare immensely skillful teachers and schools that are organized to support teachers' as lifelong learners. Although the amount of content teachers learn through professional

development activities is not apparent in the literature, it is apparent that focusing professional development on content provides opportunity for active learning. Further, if the professional development is focused on the teacher's daily practices, it is then more likely to produce enhanced knowledge and skills, resulting in a large positive effect on student achievement outcomes (Garet, Porter, Desimone, Birman, & Suk Yoon, 2001). The need for professional development to concentrate on content and pedagogy is critical. Professional development that focuses on specific content and how students can learn that content (i.e., how teachers can instruct) has greater effects on student achievement of conceptual understanding than does more a general professional development strategy (Kennedy, 1998). Watters & Ginns (1996) supported this notion by saying that teachers who participated in professional development projects focusing solely on enhancing science content only reinforced the misconception that science is a static body of principles, laws, and problem sets.

Research on teacher learning shows that fruitful opportunities to learn new teaching methods share the core features of ongoing collaboration of teachers for purposes of planning that (a) has explicit goals of improving students' achievement of clear learning goals; (b) is anchored by attention to students' thinking, the curriculum, and pedagogy, and (c) has access to alternative ideas and methods and opportunities to observe these in action and reflect on the reasons for their effectiveness (Hiebert, 1999).

The Need for Distance Education in Professional Development

Emerging technologies in distance education have been used frequently in professional development settings over the last decade. Although some institutions, most notably in countries other than the United States, are continually retraining in-service teachers online, other institutions such as Indiana University have attempted to offer a Masters of Arts degree online to answer the call for alternative certification. O'Shea (1995) suggested that virtual universities will someday allow students to work collaboratively, interacting with instructors and tutors and remote media synchronously.

In a 1996 study by the National Council on Teaching and America's Future one of the critical findings suggested that teacher expertise is one of the most important factors in student learning (Darling-Hammond, 1996). With over 50,000 untrained teachers on either emergency or substandard certificates in some 40 states, enhanced professional development is essential. Even the elementary teachers who have gone through a rigorous teacher preparation program from a 4-year institution are at a disadvantage in their explicit content knowledge due to the lack of funding provided to undergraduate programs of which they were part. Often, preservice teachers are taught by adjunct or graduate student faculty members who are themselves not expert in content knowledge (Bullough, Hobbs, & Kauchak, 1997).

Teacher knowledge and understanding of content is critical in subjects such as science or mathematics if students are expected to engage in the construction of meaningful knowledge for themselves. Teachers cannot help students learn what they don't know themselves. Although there is a large body of literature on professional development, little related literature exists on ways distance learning could play a role in addressing problems of new standards, accountability, professional development and pedagogy**,** and content knowledge (Lezberg, 1999). With new policy and reform effecting what teachers teach and how teachers teach, exploring the best ways to provide professional development before taking the classes to the masses is crucial.

The *National Science Education Standards* call for professional development to emphasize science content and inquiry teaching (National Research Council, 1996). Live

settings have traditionally been the most effective approach to providing professional development for teachers. Evaluation of effective professional development has been defined as the degree of teacher engagement during workshops and their change in knowledge or classroom practice (Loucks-Horsley & Matsumoto, 1999). Emerging information technologies can provide comparable, if not more effective, teacher professional development. However, teachers must be willing to change for professional development and reform to be successful (Gremill, 1983).

Need for Research on Distance Education

In 1998, a United States Department of Education (1998) study suggested that well over 70% of the institutions of higher education would provide distance education courses by 2003. The same study stated that an estimated 1,680 institutions were offering over 54,000 distance education courses. In 1999 The National Center for Educational Statistics (NCES) estimated that up to 70 million adult learners were involved in some form of continuing education. Currently, 5 out of every 11 students attending U.S. colleges and universities are 25 years old or older (NCES, 1999). Due to the availability of distance courses, by the end of this decade it is estimated that the number of students over the age of 35 will outnumber students that are 18 to 20 years old. These figures might explain why public 2-year colleges have taken the early lead in offering distance courses. As of January 2003, 77% of public 2-year institutions have distance education action plans in place or are in the developmental process (NCES, 2003).

Studies need to be done on the effectiveness of distance learning and its place in teacher professional development. The legislation surrounding the field of education and the need for teachers to be expert demands that professional development for all teachers needs to be done often and well. What follows is an overview of the scenario that triggered this exploratory study. Moreover, the results of a postworkshop questionnaire and follow-up interviews will shed light on how videoconferencing technology might be the answer to reaching rural, isolated teachers for the purposes of professional development.

Methods

This study came to fruition due to a technicality. In the third year of a 5-year professional development project, it became clear that available funding would not cover the travel, lodging, and per diem of approximately 100 of the teachers and staff members participating in the project. After much deliberation, the project staff decided on finding a central location that would accommodate a 3-day workshop and would be within a 45-minute commute for the teacher participants. The result of this logistical analysis was successful in that all but 13 teacher participants lived within the 45-minute commute to the proposed central site. The 13 outlying teacher participants who would have to drive approximately 90 miles each direction over state and county roads provided the dilemma that drove this innovation. Therefore, the purpose of this study was to evaluate the effectiveness of using point-to-point videoconferencing for the purposes of science teacher professional development for elementary school teachers in rural settings.

Sample

The teacher participants of this study consisted of 107 elementary school teachers from rural districts in Northern Missouri (94 from the central site and 13 at the remote site). All but two were female and they were all of Caucasian descent. Their teaching experience ranged from first year teacher to 32 years in the classroom.

The 13 remote site teacher participants were from two different districts. However, they all knew each other from academic year professional development provided through the Science Co-Op Project. Moreover, the community of practice between many of the teacher participants at both sites had already established through previous summer and academic year professional development.

Workshop Description

Each school district participating in this project was given a Polycom™ unit (a stand alone videoconferencing solution that compresses video and audio and delivers data over a high speed connection) for the purposes of professional development of science content during the school year. Since the remote site already had a Polycom unit and its regional support staff was well versed in its use and function, the solution to the dilemma was to establish a point-to-point videoconferencing connection between the central and remote site. The regional support staff is comprised of either the school principal or the district's science supervisor. These designated leaders worked closely with the project staff in designing and facilitating the teacher professional development during the summer and throughout the school year.

The sites were able to communicate over T-1 lines that connected the main site's Polycom unit to the remote site's Polycom unit (see Figure 1). The project staff attended the central site while a member of the project's regional support staff facilitated the workshop at the remote site.

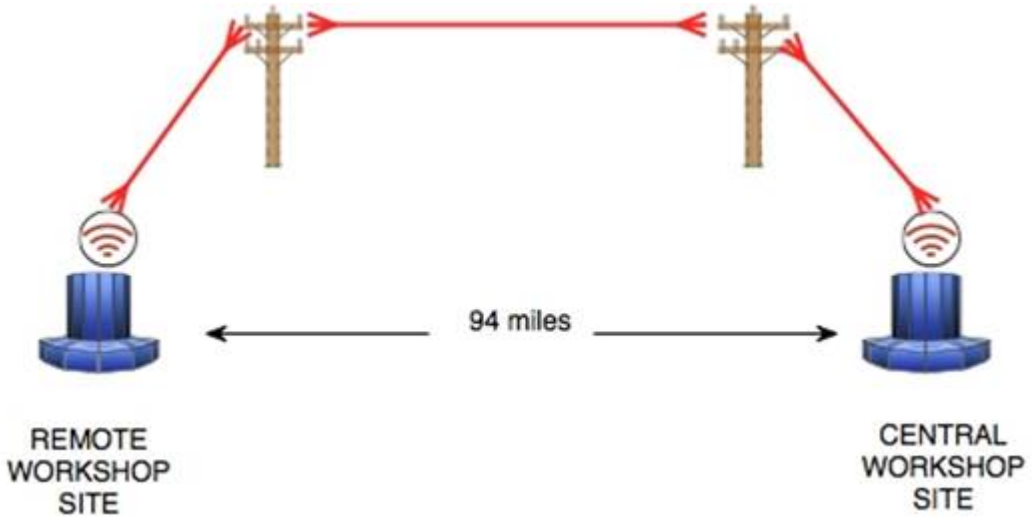

Figure 1. *Videoconference connection and distance between workshop sites.*

The focus question of the study became, "What affect would the integration of point-to-point videoconferencing have on teacher participants in both the central and remote workshops sites?"

The 3-day workshop focused on inquiry teaching, questioning, science content, and reflective journaling. The workshop was designed to meet the needs of the teacher participants at both locations. In each of the 3 days the participants engaged in the following schedule:

Day 1: The teacher participant worked on adapting science curriculum kits through team and peer evaluation of activities in the teacher guide and activities already performed in the classroom. With the guidance of the project staff, the activities were modified to adhere to state science content standards and to meet the spirit of inquiry.

Day 2: The first day was continued with more refining of the kits and sharing of ideas across the two sites. The project staff led the afternoon session on how to use questioning strategies within the context of the kits.

Day3: The final day of the workshop consisted of scientists from various universities sharing their research and answering questions to clarify and refine science content understanding amongst the teacher participants.

The project staff was able to reach the remote teacher participants and create a joint community of practice through prior planning. Staff members met with the remote site facilitator prior to the workshops and prepared him as if he were one of the staff. Further, during the workshop one of the project staff members at the central site was assigned to the remote site to ensure that communication lines did not break down.

Data Collection and Analysis

Since this method of delivering professional development for a multiday workshop had not been studied prior to this investigation, an emergent design plan allowed for flexibility to discover and address issues as they arose.

Data were collecting through triangulation in the forms of a postworkshop questionnaire and follow-up phone interviews. During the 3-day workshop, the researchers observed and facilitated the communication between the two sites. Questionnaires were distributed to the remote site teacher participants, then collected and mailed to the researcher by the remote site facilitator. The questionnaire consisted of six questions all of which were based on 5-point scale with an open-ended component for additional comments. Finally, all 20-teacher participants were sampled from both sites and were interviewed by phone and/or email. The interview consisted of four lead questions with multiple probing questions based on the teacher participant's response to the lead question. The main objective of the interviews was to elicit contextual facts and perceptions of establishing one workshop from two different locations using a videoconferencing application.

Observation and interview data was analyzed through NUDIST (N6) software, which provided emerging themes in the participant responses. Data from the questionnaire was analyzed and reported as frequencies. The frequencies provided the interview protocol that was used post workshop. It became obvious through observation that this workshop strategy proved successful, as the goals of the workshop were accomplished at a high level.

Results

The affective responses of the participating teachers at the remote site were investigated through a postworkshop questionnaire and through follow-up interviews. The results of the 6-item questionnaire are shown in Figure 2.

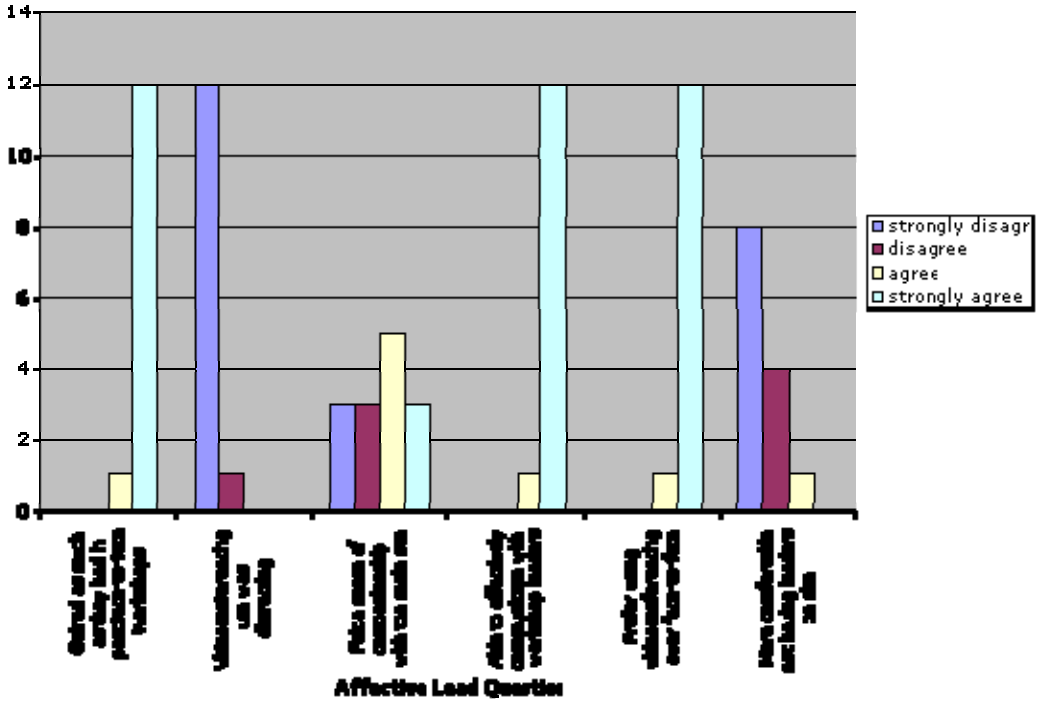

Figure 2. *Frequency responses to the post workshop questionnaire.*

The majority of the remote site teacher participants reported that they gained as much from this workshop by using point-to-point videoconferencing as they had in the past traditional face-to-face workshops. Some of the follow-up responses to this question delved into the fact that travel was removed from the equation: "I guess the trade off of not having to travel 4 hours each day kept me more focused," and "This was a great idea! I definitely felt like I got more accomplished than in the past since I wasn't in the car that long."

An original concern of the project staff was that the videoconferencing equipment might be a distraction to both the workshop leaders and the teacher participants. Although, all of the 13 teacher participants at the remote site had experienced some sort of distance learning through videoconferencing, none of them had experienced its use for these purposes. In fact, the staff and the teacher participants became numb to the technology. One respondent stated, "It became less of a distraction once I was sure the workshop leaders wouldn't forget about us."

The concerns of having a central workshop site with a remote site that did not have the workshop leader present were almost overwhelming for the project staff. The staff's concern was not so much with what would occur at the remote site, but rather that the leaders at the main site might forget about the remote site. Forgetting about the remote site might ultimately cause a breakdown in communication and have a subsequent negative affect on the teacher participants. The fourth question of the postworkshop questionnaire addressed this issue. Two of the responses were as follows: "They were readily available," and "They never forgot about us. They are the best!"

Yet another area of concern was making sure the teachers at the remote site felt like they were part of the workshop and not a small, outlying group. When asked if they felt a sense of companionship/collaboration with the teacher participants at the main site, the responses had the most variance. Almost half of the remote teachers did not feel like they were part of the big picture, as in the following example quotes:

> "The companionship here was great. I didn't feel the need to communicate with the other teachers at the other site."
>
> "We didn't get to share ideas with the central site as much as I would have liked."
>
> "I prefer a small group anyway. I never liked going to workshops where there was 100 or so teachers. This was fine by me."

Again, an overwhelming majority of teacher participants said they preferred using videoconferencing as opposed to participating in a traditional, face-to-face workshop. Mostly, this was due to the travel issue, as in the following statement: "This beats driving. If I needed something I can get it here or just hit the mic and the leaders were able to answer the questions I had."

Table 1
Interview Lead Question and a Sample of the Responses

Lead Question	***Response***
What were the advantages of having a multi-day workshop using videoconferencing technology?	We were able to get a lot of work done.
	No travel. This was a huge advantage. Also we had all of teaching material on hand since the workshop was at our school.
	I was close to home and could see my kids every night.
	Closer group interaction & no driving.
	We effectively used technology to save time & money.
What were the disadvantages of having a multi-day workshop using videoconferencing technology?	The science guests were not in person and we didn't get any handouts or were able to talk with them.
	Not having the leaders here. I love talking with them outside of the professional setting.
	I miss talking with others from other schools.
What changes would you suggest to using videoconferencing more effectively in future workshops?	I would like to be able to hear the other sites teacher's ideas more.
	I would suggest eating lunch in front of the cameras. We cold then talk about stuff other than teaching with the leaders.

The final question asked if the teacher participants felt more comfortable not having the workshop leaders present. Some teacher participants reported a sense of intimidation from university faculty members in previous studies (Anetta, 2004). The majority of the teacher participants disagreed with this notion, as in the following comments: "We **did** have them here," and "It felt like they were in person."

However, others felt differently. This difference might be attributed to the interpersonal relationships that had been built over the first 3 years of the project: "I would have liked to see them. I miss them!" and "The videoconferencing was fine but it is not the same as having them in person. They are so much fun to be around."

The follow-up interviews shed some light on these responses and dug deeper into the teacher participants' true feelings of the use of videoconferencing for a multiday workshop. Twenty teacher participants (10 from each site) were sampled, and selected responses are reported in Table 1.

Conclusion

It is no surprise that the overarching response from the teacher participants' dealt with the lack of travel. This reason is, in fact, a major factor in the success of distance education as a whole (Garrison, 2000). It can be gleaned from these data that decreasing travel time also saves money and keeps the participant more alert and, therefore, more effective.

This study accomplished the task of answering the question, what affect would the integration of point-to-point videoconferencing have on teacher participants in both the central and remote workshops sites? The answer is it can be very effective; however, a few caveats need to be addressed if this successful scenario can be replicated.

Implications for Practice

The teacher participants at both sites had experienced the use of videoconferencing in previous years of the project. Therefore, the technology used was not a novelty. It was simply another artifact that the project staff used to communicate with them. Also, the teacher participants and the project staff had a fairly close relationship. This is especially true with the principal workshop leaders. He and his wife had become actively engaged in the lives, in-and-out of school, of many of the teacher participants. There was a strong level of trust that had been built between these groups and the attempt to try something new did not scare the teacher participants away. Although this was not part of the postworkshop interviews, it was clear this relationship had a strong affect on the participants.

Providing rural science teachers with professional development using videoconferencing can certainly be a viable solution to meeting the goals set forth by current reform. A successful workshop using videoconference has many intangibles. Such intangibles are an established relationship and level of trust between the teacher participants and the workshops leaders, a well-informed facilitator at the remote site(s) who can provide leadership and take the role of the talking head for that site, well-informed technicians in place to work the technology, and a well-thought-out workshop plan to include all teacher participants in all phases of the workshop. It can be argued that if teacher participants are satisfied with their experience, then success is inevitable.

Moreover, it is critical to include both school administrators and scientists in the reform initiatives (Ballone-Duran, Gerniak, & Habey; Czerniak, & Haney, 2005; Weinburgh, 2003). Administrators who came to the workshops to support, and in some cases participate in the workshop activities, proved positive in the affect on the teacher participant attitudes. At the remotes site, the facilitator was the local school principal. Having this person acting as the liaison between project staff and remote teacher participants became the crucial cog in the success of this experiment. In this project, scientists acted not only as content specialists but as experts in how science is done. This seemed to add credibility to the process of inquiry that drove the workshops.

It was also important to be sure experienced teachers were teamed with inexperienced teachers. The mix of classroom experience and technology and inquiry training between the experienced and inexperienced teachers, respectively, added to the dynamics and sense of community. This proved to be successful in the Memphis Restructuring Initiative as well (Ross, Stringfield, Sanders, & Wright, 2003). Hamilton also reported that this dynamic impacts student achievement (Hamilton et al., 2003).

In conclusion, this study provides insight for professional development leaders at all levels, in all content areas, and almost all countries. It augments our understanding of the effectiveness of reaching rural, isolated populations and technology's ability to assist in that goal. It also has provided a model for future studies. As the *No Child Left Behind Act* is driving education, there needs to be continued strides toward innovative approaches for reaching all teacher participants and students regardless of their location. Videoconferencing is just one feasible way of accomplishing this task. As emerging technologies become more streamlined, there will be avenues for synchronous communication without using videoconferencing networks or equipment used in this study. The future is now and education is the only way to the future.

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