Content-focused Technology Inquiry Groups: Cases of Teacher Learning and Technology Integration

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Background on Technology Professional Development for Teachers

Though benchmark research (Sandholtz, Ringstaff, & Dwyer, 1997; Sheingold & Hadley, 1990) established that teacher learning about and integration of educational technologies in PK-12 settings is a lengthy process requiring a commitment, in some cases, of five years or more, few teachers have access to long-term, ongoing professional development opportunities that offer thoughtful, subject-matter-based technology use. For example, in 1999, teachers received only 5.9 hours of teacher training on "integrating technology into instruction" (*Survey of technology in the schools*, 1999). These minimal training hours are predominantly organized as short-term, one-shot workshops focused on learning software without specific content-based examples of their use (McKenzie, 2001) and without pedagogical and curricular connections (Zhao, Pugh, & Sheldon, 2002).

This symposium highlights the recent shift toward ongoing, content-based technology preparation for inservice teachers. Currently, a critical mass of collaborative school-university professional development partnerships have been established to further teachers' technology learning so that technology may be used in ways that amplify or transform learning in the classroom (Pea, 1985). Evidence that school districts are moving away from the short-term approach and building in long-term, ongoing professional development (Bradshaw, 2002) provides some degree of confidence that these initiatives may be adopted by more schools and districts in the near future.

Four approaches to long-term, technology professional development are included in this symposium, and all are theoretically grounded in a situative perspective on knowledge, thinking, and learning (Putnam & Borko, 2000) that involve three central concepts – "cognition is (a) situated in particular physical and social contexts; (b) social in nature; and (c) distributed across the individual, other persons, and tools" (p. 4). Though the professional development approaches involved in this symposium are grounded within a situative perspective, they vary on these three central concepts. The question that will be explored in this symposium is: <u>How do these variations in situative approaches to technology professional development impact teacher learning and development?</u>

In this paper, we describe the professional learning model, *Content-focused Technology Inquiry Groups*, (Hughes, Kerr, Ooms, & Palmquist, 2003; Hughes & Ooms, in press) that has been developed at the University of Minnesota to collaborate with teachers in schools.

Content-focused Technology Inquiry Groups

A Research-Based Origin

The *Content-focused Technology Inquiry Group* is a professional learning model that was developed as a practical response to past research completed by the first author. Hughes (2003) developed a learning model that projected path(s) teachers might follow as they engaged in learning how to integrate technology. Phases of the model include the individual, an initial learning experience, reflection, exploration, technology use, evaluation, and rejection. Teachers' pathways through this learning model did not follow a linear, stage progression. The knowledge and experience teachers possessed and the nature of the technology learning experience, together, led to multiple pathways through the model and impacted teachers' ability to integrate technology in support of subject matter learning. Complementing those findings, Hughes (in press) examined the roles teacher knowledge and learning experiences play in forming technology-integrated pedagogy in the K-12 classroom. This research suggested that the power to develop innovative technology-supported pedagogy lay in the teacher's interpretation of the newly learned technology's value for supporting instruction and learning in the classroom; learning experiences grounded in content-based, technology examples were most effective toward this end. Furthermore, teachers with less professional knowledge (e.g., preservice or novice) and/or less intrinsic interest in identifying uses for technology may need guided or collaborative, content-specific technology learning opportunities, while teachers with more professional knowledge (e.g., veteran) may be able to develop innovative technology-supported pedagogy by bringing their own learning goals to bear in professional development activities. Collectively, these findings led the first author to develop a professional learning model, *Content-focused technology inquiry groups*, as a practical solution that offered professional development aimed to support all teachers' learning to integrate technology into their subject areas.

The Model

The core of our model is the practice of collaborative inquiry (CI), a learning approach that involves small groups of teachers who collectively investigate pedagogical and content issues, (e.g., Bray, 2002; Crockett, 2002; Kasl & Yorks, 2002; Ladson-Billings & Gomez, 2001; Zech, Gause-Vega, Bray, Secules, & Goldman, 2000). Our model aimed to enable teachers to reflect on their own beliefs through discussion, to provide access to alternative practices and beliefs that are reflective of their subject and grade level (through use of video cases, lesson plans, and team-teaching), to observe the positive impact these practices have on students' learning, and to engage in learning over time. These elements, taken together, form a cross-section of characteristics that research has shown to facilitate change in practice (Darling-Hammond & McLaughlin, 1996; Putnam & Borko, 2000; Richardson & Placier, 2001; Sandholtz, Ringstaff, & Dwyer, 1997).

As mentioned, the first author's past research (Hughes, 2003; in press) discovered the crucial role that content knowledge and identified problems of practice played in teachers' pathways to thoughtful technology-supported pedagogy. Thus, our model very specifically calls

for inquiry groups that are content-focused. From our perspective, content-focused indicates that the group members agree upon a content area around which to identify issues/problems that technology may ameliorate or solve. We privilege a content-focus as opposed to a general pedagogical focus (such as a group of teachers interested in classroom management) or general technological skills (such as a group of teachers interested in PowerPoint), as we feel the content-focus leads to technology-supported pedagogy that puts the technology into the hands of the students as a tool for learning content. Past research (Snoeyink & Ertmer, 2001/2002) has also identified that a lack of common subject area among participants in technology professional development is an impediment to learning.

We also must acknowledge that individuals from the university joined the teacher inquiry groups as active participant-researchers. So in addition to leading research-related activities, the university participants engaged as full members of the inquiry groups. Though these roles easily could change in the future in response to future research findings or future groups' requests, at this point we participate in the group activities for several reasons. Because our background is in the areas of technology integration, we feel an ethical and moral responsibility to share any knowledge or experiences we have, as it pertains, with the teachers. We wonder to what extent our participation and our ideas about contemporary research related to learning, teaching, and technology might serve to create "cognitive conflict" within individual teachers' minds – that, in turn, prompts teachers to act upon such conflict. Finally, we anticipated that the teachers' ideas and inquiries would provide valuable school-based insights that would be vital to consider in future research, theory, and university coursework.

Halverson School Technology Inquiry Group[i]

In 2002, we began collaborating with an urban K-8 school, Halverson School, in which teachers had expressed interest in the inquiry group professional learning model. Though many teachers expressed interest, one group formed into an active technology inquiry group. This group started collaborating in March 2002 and included three humanities teachers, one music teacher, one middle school coordinator, and university participants (one faculty member and up to three graduate students).

The university participants were initially drawn to Halverson as a potential collaborator in this project for several reasons. At the beginning of the 2001-2002 school year, the school had secured funding that enabled the addition of one computer laboratory, updating of an older computer lab, the addition of new network wiring, and the intention to place three computers in each classroom by 2004. With access to the Internet and computers in their classrooms or in an available computer laboratory, Halverson teachers find themselves with availability but not necessarily the knowledge or direction to use these resources for technology-supported problem-based learning in content areas. At the same time, Halverson School's district adopted mandatory inquiry learning groups for professional learning by all faculty and staff in all schools. Finally, Halverson School is an urban K-8 school. Of Halverson School's 610 students, 83% are eligible for free/reduced lunch and 47% receive ELL service. At this point in 2001, the school's technology predominantly was used for media classes and individual remediation with computer-based math or reading learning systems, uses that were distant from the content area teachers' daily learning activities.

Our interest in collaborating with Halverson teachers was reciprocated, and due to the teachers' ability to choose inquiry topics of their choice for the mandatory inquiry learning initiative, a Halverson teacher group formed around the technology-supported arts and

humanities integrated curriculum. Three middle school humanities teachers, Cory, Holly, and Frank, one music teacher, Maureen, and the middle school coordinator, Nora, developed an arts-humanities technology inquiry group. In addition, one educational technology professor, Joan, two graduate students in educational technology, Ann and Shantia, and one undergraduate student in English, Terry, participated.

The inquiry group activities all occurred at Halverson School. The group began with a bi-monthly group meeting between March and May 2002. In the following academic year, 2002-2003, the group decided to engage in group meetings only once a month in order to have time to engage in productive work between meetings. The group meetings either took place in Nora's curriculum coordinator office, a small room that held two desks for Nora and another staff person and a larger conference table that accommodated about six people, or in Cory's classroom, a very large room with student tables and seven computers. The university participants were available to work with individuals or small groups at almost any time they desired. In addition, the teachers had informal opportunities to collaborate with each other between group meetings.

Each participant had varied access to technology tools. All teachers had access, through a check-out system, to a computer laboratory in the media lab. In addition, they could send small groups of students to the media center to engage in research at any time. Cory's classroom had seven computers grouped together in one corner of his large classroom. Frank, Holly, and Maureen had two computer stations, grouped together on a side wall, in each of their classrooms. Nora had access to a laptop, stored in a closet in her office. Additional technology resources, such as software and hardware, were available from the school media center or the university participants. Table 1 summarizes the situative characteristics of the Halverson Inquiry Group as it was initiated in March 2002.

Table 1
Situative Characteristics of Halverson Inquiry Group, March 2002

Physical Context	**Social Context**	**Social, Discourse Communities**	**Tools**
• K-8 School • Urban location • Teacher classrooms	• Face-to-face • Teachers • Curriculum Coordinator • Professor • Graduate students	• Middle School • Humanities Teachers • Research Group • Inquiry Group	• Performance tools • Humanities Curriculum • Music Curriculum • Technologies, including computers, software, overheads, Internet

Methods

Research Design

The research method implemented in this research project is a longitudinal, multiple-case embedded research design (Yin, 1994). The inquiry group is the case and the primary unit of analysis; embedded cases are the practicing teacher and technology-supported practice in the classroom. The research reported in this paper focuses on the embedded cases in order to understand the teachers' technology learning and integration from March 2002 through June

2003. Past research (Hughes & Ooms, in press) examined the inquiry group as a case from which we developed an explanatory theory (Yin, 1994) underlying the establishment and sustenance of the inquiry group.

Research Data

The data generated in this study involved an initial (pre-involvement) interview with participants that focused on the participants' experience as an educator, as a teacher of the discipline chosen for inquiry, and as a user of technology. Interviews were repeated with all participants on an annual basis. Classroom observations were conducted monthly for all teachers and were captured in written field notes. Inquiry group meetings occurred monthly and were audiotaped and transcribed. Meeting agendas were archived. Individual meetings and consultations with participants were logged in field notes. The inquiry group meeting transcripts were member checked by participants for transcription errors. All data were compiled in Nvivo software to facilitate both qualitative and quantitative analyses. Finally, we provided participants a draft manuscript for their response to our interpretations of the data.

Data Analysis

The inquiry group case study relied on theoretical propositions (Yin, 1994) as the general analytic strategy. Based on past research and literature reviews, this project followed the proposition that the situative characteristics inherent in content-focused, technology inquiry groups would facilitate teacher learning of technology and teacher use of technology for subject-specific student learning activities. This proposition led us to focus on the data mentioned above. We used the explanation-building analytic strategy, a type of pattern-matching, to build an explanation regarding teacher learning and technology integration in each embedded case.

The primary data sources for these analyses were the inquiry group meeting transcripts, meeting agendas, the pre- and post- teacher interviews, and classroom observations. These data had been coded using twenty-four top-level codes generated from previous research (e.g., Hughes, 2003; in press) as well as the wider literature on inquiry groups and teacher learning. In addition, analysis of words spoken and turns taken by participants (Tannen, 1989) was conducted on the inquiry group meeting transcripts to identify participation trends. Two researchers coded the data set and consensus was reached on all coding.

We then engaged in an iterative process of explanation-building (Yin, 1994). First, using frequency tables of all coding, we examined patterns for each embedded case (i.e., each participant) and began an initial case development regarding the teacher's learning and technology integration. Second, we considered the theoretical characteristics of the situative perspective on teacher learning (Putnam & Borko, 2000) and compared our initial case against those characteristics (e.g., In what ways did the physical context shape learning?). We revised the case and continued in this fashion until we had exhausted our data and the theoretical characteristics of the situative perspective. Finally, we engaged in cross-case analysis by comparing our embedded cases with each other to discern disparities or patterns. We have engaged in a gradual building of an explanation that is in its formative stage. Further research will allow continued refinement of this explanation.

Results

In our Results section, first we share the teacher cases in order to offer the reader our first layer of results from the analyses. Then, we offer results concerning teacher learning and

technology integration from the perspective of the inquiry group as a whole, or, in other words, the embedded cases considered as a whole.

Cases of Teacher Learning and Technology Integration

Maureen: A Case of Competing Responsibilities

Maureen, a veteran music teacher with eighteen years of experience (twelve years in the urban district in which this study occurred), possessed a strong interest and ability in technology integration as she held expertise in Yamaha keyboard technology as well as emerging use of iMovie and was pursuing National Board certification during the 2002-2003 school year. Across time, her music classroom has grown smaller in size but larger in resources, with increased access to guitars, drums, electronic keyboards, xylophones, piano, and music CDs, obtained through grants and the expansion budget for adding a seventh and eighth grade to the school.

Negotiating Being Part of the Group. Maureen's participation was heavy in the first three months of group work (see Table 2). It was during this time that Maureen helped negotiate the focus for the group as well as the nature of future technology inquiries, both individual and group inquiries. At the first meeting, Maureen questioned her role in a group that included three humanities teachers, "Will it matter that music, what I am doing is probably totally different from [the humanities teachers]? It would be kind of cool to tie in some music with humanities…" (3/02 Meeting). Nora quickly proposed an idea that met with approval from the group, "One thing that would come out of this is that we could do something with the music that can tie in…" (3/02 Meeting). The group then spent a majority of the meeting discussing what the humanities teachers were currently teaching and what ways music could be integrated with those topics. For example, Holly's class was studying the Civil Rights, and Maureen offered, "so we should be doing some protest songs" (3/02 Meeting). After this period of identifying potential integration ideas with the current curriculum being taught, the group solidified its interests for the inquiry group activities, summarized by Nora's statement:

> Nora: So, maybe that is our goal. Maybe our first goal is for us to define the humanities curriculum. Maybe our whole goal is to integrate humanities and the arts. Overall, bing bing bing.
>
> Maureen: Yeah, I like that.
>
> Nora: And then in that, one of the steps would be to clarify what each other teaches or what is demanded of us already. Actually, it comes down to standards. What standards are you demanded to address and you each in music and art, what are you demanded to address. And then look at, the next step being where can we integrate these? Does that make any sense at all?
>
> Maureen: It does… (3/02 Meeting)

The explicit and significant role for the music teacher and the humanities teachers had been established along with the overall goal of the group to integrate across curriculums. In addition, Nora and Maureen also discussed the extent to which participation in this inquiry group could also fulfill some of Maureen's requirements for National Board Certification such as working with a peer group and a wider community of practitioners and focusing on technology use and/or integration across disciplines. Within the first two months, Maureen's role in the group as well as her benefit(s) from participation had been thoroughly analyzed and identified.

Inquiry Ideas. Maureen brought to the group specific technology needs she had for her class as well as developed new inquiries that emerged from conversations with the group

members. At the initial group meeting, she possessed an interest in having a laptop with a projector as well as recording equipment in her classroom –to record oral performances, such as the choir, and instrumental performances, such as keyboarding. In addition, she and Cory had an informal agreement to collaborate but had not determined the content of such a collaboration.

During the meetings in May 2002, the inquiry group spent concentrated time discussing humanities and music curriculums in an attempt to identify ways to collaborate and integrate content across disciplines during the 2002-2003 school year. At this point, the group was working from the agreed upon "humanities-music integration" focus for their inquiry work. These discussions and potential integration were complicated by the fact that the humanities teachers loop across the 6, 7, and 8th grades and in the 2002-2003 school year each would be teaching a new grade's curriculum, as the school had recently added the 7th and 8th grade. In addition, Maureen's music classes included students across grade levels so there never was an exact match between Maureen's students and any one of the middle school humanities' classes. Maureen brainstormed a project around the time of the Harlem Renaissance for Holly's class that involved creating CDs of important musicians like Duke Ellington and James Johnson. Ultimately, in these sessions, due to the constraints within which the teachers worked, Maureen felt that "…the way this is kind of shaping up to me is that I'll be looking at what's happening in the humanities and feeding stuff in. And kind of peripherally doing some stuff in my room that fits. But because of the mixed ages it may be hard to really apply this in my own classes" (4/4/02 Meeting).

Maureen's keen sense regarding the nature and process of integration was accurate, as in May 2002, Nora summarized to the inquiry group a request she made to the principal:

> We've asked for a workshop day during the school year between now and the end of the year for us to just inventory and examine the materials we have. Then we've asked for workshop time as soon as school's out to really put these units in place and look at what kind of teaching we want going on, and writing syllabuses for the classes. (5/3/02 Meeting)

Maureen astutely inquired, "Tell us how do you anticipate including the integrative piece with that?" (5/3/02) as she noticed that the workshops requested were focused on organization of humanities curriculum but neglected the integration of the arts. The group then decided that the arts would be considered after humanities teachers had established the curriculum and were "looking more at how you're actually going to teach it" (5/3/02). Thus, the group had decided that the process of engaging in humanities-arts integration involved (a) determining humanities curriculum, topics, and teaching techniques and then (b) involving Maureen to collaboratively identify promising cross-curricular ideas.

The Challenges of Engaging in Inquiries. Maureen's engagement in technology inquiries – both her self-identified inquiries as well as the humanities-arts inquiries – remained un-initiated during the year. Maureen acknowledged that lack of time was the largest challenge, especially because she was also engaged in the National Board Certification process. After September 2002, Maureen's participation at meetings dramatically decreased (see Table 2), though the university participants continued to provide her information and resources (in October 2002) related to her specific music-technology inquiries such as sound-recording equipment. Maureen, however, did not have the time to review these materials, yet she indicated she wanted to work with us on them in January 2003. In January, though, she exclaimed "to tell you the honest truth right now I am wired in National Board… my portfolio is due February 15 and I am hanging by my finger nails" (1/03). Yet, in March, she was overwhelmed with attending to all

the school-related matters that she had dropped due to her focus on National Board Certification. In May 2003, one of the university participants did meet with her to show some sound recording software that she liked and requested to be purchased for her classroom.

Similarly, the music-humanities integration was neglected during the year for several reasons. First, the humanities teachers did not come together and plan their curriculum during the summer, as they intended to do. Thus, Maureen had not been able to meet with them to identify cross-curricular integration ideas. Furthermore, as the 2002-2003 school year began, Maureen attended the meetings less frequently, and the discussion in the inquiry group meetings naturally shifted to a sole focus on the humanities curriculum. When Maureen attended the meetings in December and January, she expressed frustration that music-humanities integration, specifically a project she and Cory had intended to develop using portable CD players (that the school did not own) to share music across their classes, was not occurring. It was only in December 2002, when Maureen realized that Cory was teaching Ancient Civilizations the entire year, and she noted the main problem, "You know it's not like we have music consistent from that time" (12/02). Yet, in January 2003, Cory, Maureen and Holly discussed the project, acknowledging that his main curricular topic was not the best fit, but ultimately concluded with a nebulous agreement that Maureen would support Cory's students study operas during the days of Greek and Roman gods:

> Holly: but do you have to do a direct collaboration that way or can you be just supporting Cory and
>
> Maureen: yes, I can just be supporting Cory, that is right, with whoever [students] you got
>
> Holly: because he has enough musical background that he can
>
> Maureen: yes. If I can just help you with the background stuff and you do it, that would be great
>
> Cory: Yes, either way, that is fine with me. And if you do something with those kids I can do, well I have a small group of those kids, I mean, everyday, that is just the way our rotation works, I can do stuff there with them, you know. I don't know what you are going to do with … (3/03)

Ultimately, neither Cory nor Maureen followed up on this integrated project and it was never initiated nor completed.

We suspect that Maureen might have experienced success in an inquiry group that focused on music and technology integration in a school setting that offered some way of reducing workload and committee responsibilities in order to shift time to inquiry activities. In fact, at the end of the year Maureen explained, "I tend to get a lot more out of things that are more specifically music geared. I mean if I could sit with a number of music colleagues and talk about many of these same issues, I would probably arrive at solutions a lot faster" (Interview 6/03, p. 6). Maureen's experience in this past year's inquiry group reiterated the importance of participants' full participation as well as constant monitoring of the content-focus of the inquiry group.

Table 2
Participants' Presence at Inquiry Group Meetings 2002-2003

Meeting Date	3/02	4/02	4/02	5/02	5/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03
	Presence at Meeting (P)													
Maureen	P	P	-	P	P	P	-	-	P	P	-	P	-	-
Cory	P	P	P	P	-	P	P	P	-	P	P	P	P	P
Frank	P	P	-	P	-	-	-	P	P	P	P	P	P	P
Holly	P	P	P	P	P	-	-	P	P	P	Maternity Leave			
Nora	P	P	P	P	P	P	P	P	P	-	P	P	P	P

Cory: A case of scaffolded technology learning and integration

Cory, a teacher with five years' experience, has been teaching humanities at Halverson for four years. He feels comfortable using technology and, with a bank of computers in his classroom, his students have used them to do Internet research. He has personal interests in video recording and editing.

Technology Inquiry in Geography Information Systems (GIS). In response to the humanities teachers' need for geography to be integrated more extensively throughout their program, the university participants demonstrated the Geographic Information Systems (GIS) software twice in the early months of the inquiry group. All three humanities teachers felt it potentially could address their curricular needs, and Cory adopted GIS as his technology inquiry for the year. In September, Nora summarized the inquiry goals across the group and mentions that the GIS software would be installed on Cory's classroom computers. Cory confirms this and explains how access to GIS would enable small groups of students from any humanities class to use them:

> You could put it on the computers in my room… I have seven computers so if you came in we could split into you know two, three groups of seven and we could just make like a rotation where we could be doing that when I could be doing that with other people. And then if Frank wanted to do it, then we could just flip and he could come into my room. (Cory, September 18, 2002 Meeting)

Installing GIS in Cory's classroom made GIS a ready resource for all humanities teachers; whereas installing it in the media center would have created possible scheduling conflicts (e.g., if other teachers reserve the lab for other uses) lessening its potential use.

Unfortunately, the installation and preparation for using GIS was problematic. First, the installation of GIS software was not completed until December. The school's network security software was configured in a way that prevented the software from operating. The issue was resolved after the school technician and the first author spent several hours trouble-shooting the problem. Second, the inquiry group intended to purchase a GIS resource book for teachers that included a series of lesson plans and the requisite data files. Though the ordering information had been given to the appropriate staff two or three times, the book never arrived.

In the meantime, though, the university participants shared GIS lesson plans and resources that were available at a reputable site on the Internet with the teachers and organized a training session in response to the group's request in November in which the teachers completed an actual student lesson on latitude and longitude.

Cory's Inquiry into GIS. Once GIS was installed and functioning in mid-December, Cory was finally able to seriously consider using GIS with his students. In January, Cory voiced his first idea – to have his students go through the latitude and longitude lesson. Holly, always considering the extent to which geography is integrated within the humanities topics, questioned Cory about his intentions:

> Holly: are you just going to do an overall geography piece?
>
> Cory: no, I was going to, I would have them do that, like I have been sneaking geography in here and there when we have the chance. But now we have been concentrating heavy on Egypt, but I wanted to get them just to explore that first and then see what we can do [with GIS].
>
> Holly: right
>
> Joan: explore?
>
> Cory: do that like that first lesson [latitude and longitude] so that they can see you know, I think they will think that it is kind of cool that they can do that, and then you know, I guess, like you [Joan] said, you can check their database and find out if they have stuff on Egypt or
>
> Joan: or Greece and Rome because
>
> Cory: yes, we are going to get, but, I mean, let's just see if they understand what they are doing and then we can start doing that or even early China or early India and we will move into that eventually. (January 2004 Meeting)

Cory asked the university participants to teach the GIS lesson to his students, as he described, "You guys [university participants] are going to show the kids and then I can just, you know, listen in, but I can, I will probably work with the other [students] to make sure that they are doing stuff" (January 15, 2003). Across a month, Joan taught the lesson to small groups of 7 students in Cory's classroom. After this "exploration" was completed, Cory reported, "I think [my students] enjoyed it. And I think they were just waiting to figure out ways to do some more with it. I guess that is where we are at" (February 2003).

Cory recognized that GIS might be a better match with other topics within the humanities, as he felt that it might better fit with Frank's topics, "I think that the GIS thing will be big for you (Frank) next trimester. You are doing the depression and stuff, right? …It will work better with American history type of stuff, I mean. Like Egypt, they don't have a lot of data I don't think" (February 2003 Meeting). Nonetheless, Cory continued to talk with Joan about ways he might use GIS with his students, and she agreed to investigate. In March, Joan presented some ideas in the large group meeting:

> Cory and I had talked about what we could do going forward with his class if he wanted to continue to use GIS, and I just came up with some ideas and looked around to see what was around. I even have been looking at Rome and Greece. There is not a lot of actual GIS data in those time periods, but the connection that I can see from the lessons that were available on the web, was to do a theme of expeditions, or travels, and you may, I mean, there is one on the Bancroft expedition, but I could see how that may feel like you're bringing up a whole other thing, but, anyway, that was just one idea. Or you could just do the kind of basic geographic things like measuring distances, between the cities on the journey of Odysseus and then one other extension is you could have kids pick a city and look at what it is like now and kind of do a comparison/contrast if you were going to take this route now what would you come into contact with… (March 2003 Meeting)

Nora was very excited by the idea of expeditions, yet Joan suggested that she felt the next step was for the teachers to really learn the software prior to having students use it again. Nora immediately suggested scheduling a teacher workshop and hoped the university participants might use the Lewis and Clark GIS lesson in the workshop. In addition, Nora suggested scheduling another attempt at using GIS with students:

> Joan: and what would be the agenda for that day?
> Nora: could we look at the Ulysses' trip?
> Joan: Oh. OK. Mean, have them [students] do something with that?
> Nora: yes
> Joan: well, OK. I think, Cory, you will have to look at what I gave you and decide what you want to do and then maybe we can sit down.
> Cory: yes, I have lots of ideas of what
> Joan: Figure out if it is, how we could do this with the GIS and
> Nora: if it works? (March 2003)

Though Cory is amenable to the plan, this second use of GIS in Cory's class emerges from Nora rather than Cory.

Cory planned for his students to map Ulysses' travels using GIS, yet on the day of the activity, he had not reserved the lab and had not decided all the details regarding the activity. Thus, he was not able to have his whole class do the lesson that day, but he did offer some students the option to complete it using the seven computers in his classroom. In his annual interview, Cory noted that his students were not as enthusiastic about the lesson as he was.

Cory's inquiry into Geographic Information Systems was punctuated by scaffolded learning from university participants. Cory invited and sought assistance from the university participants in teaching his students and planning future uses of the technology. However, we were somewhat mystified by Cory's seeming interest and enthusiasm for the tool but a lackluster integration effort across the year. After engaging in these analyses, we suspect that Cory may not have been intrinsically interested in GIS or that he did not see it as a "solution" to any specific problem of practice. We wonder if Cory felt undue influence to use it from the university participants, who introduced the software, or from Nora, who scheduled its installation, teacher workshops, and even classroom use.

Nora: A Case of School-based Leadership

Nora, a veteran teacher of thirty-two years of which eighteen have been spent at Halverson, assumed the middle school curriculum coordinator position two years prior to this project when the school added the seventh and eighth grades. As the middle school curriculum coordinator, Nora's main task is to coordinate the formation and maintenance of a middle grades curriculum that meet the content and state standards, is constructivist in its teaching approach, and prepares the students for high school. Nora's tasks include organizing team meetings, working on staff development, budget planning, class scheduling, and teaching students.

The Inquiry Group Leader. Nora's extensive teaching experience, her seniority at the school, and her current position situated her as a valuable resource for the inquiry group regarding the school, such as policies, budgets, scheduling, and curriculum. In the inquiry group, she assumed a leadership role, as she organized the meetings, passed information between group members, summarized and reminded group members of tasks needing completion, and provided encouragement and motivation. Nora was very knowledgeable about the standards and state mandates, which helped the group members as they discussed changes in curriculum. For

example, during a meeting in March 2002, she reminded the teachers of a new district mandate that required a one-hour reading block for every child, as this mandate held implications for both scheduling and their intact curriculum.

On many occasions, Nora expressed the group's needs and formulated ways to meet these needs. For example, Nora took the initiative to set up teacher workshops so teachers could learn the technologies in which they had interests. In addition, she creatively found ways to release the teachers in order for the workshop to last longer than the 45-minute morning inquiry slot. She also proposed procedural changes to streamline inquiry activities, "I'm wondering if we would be further ahead to have one meeting a month that's like a group meeting and then meet individually with people who have specific things that they need" (Sept 18, 2002). Nora identifies information that could usefully guide their inquiry efforts, "One thing we might want to look at just over the year is what the technology capabilities are in this school, that without spending any money, what we could do if we knew how to do it. For instance I think there are very few teachers that go down and use the red lab as an instructional tool, where all the kids can get on at once" (September 18, 2002). Nora also considered how member's reflections concerning their inquiry activities might change their current operating procedures. For example, after Frank had used AlphaSmart keyboards for writing activities in his classroom, he reflected upon the students' inclination to change font types and sizes. Nora immediately considered this issue as perhaps a middle school program issue:

> Nora: I am thinking well, we need to change them [students' patterns of writing by hand or using large fonts when on the computer] when you are going to do something with our 6 graders.
>
> Joan: what do you mean?
>
> Nora: Well, when we require writing assignments and we require it in a certain font,
>
> Frank: that is what I will do
>
> Nora: a certain size.
>
> Joan: so that they are not so focused on that kind of stuff….
>
> Joan: so, you are saying, kind of, as the students getting into 6th grade, you think maybe setting their expectations for them for writing activities throughout the next three years.
>
> Nora: yes
>
> Frank: and about presentation. What it needs to look like. There is certain standards that are just required and you can do everything you want before that, but just understand when your final is done and you have already played around with size 48, getting it down to 14 and that is truly what you wrote. So, don't be surprised when your 4 pages turns into half a page. (February 2003 Meeting)

Together, Frank and Nora developed a possible solution to implement in the future.

Nora kept the group on task and progressing through goals. She summarized and acknowledged goals as they emerged. For example, at the initial group meeting, she was instrumental in stating the overall goal for the inquiry group, "Maybe our first goal is for us to define the humanities curriculum; maybe our whole goal is to integrate humanities and the arts" (March 23, 2002). Yet, she also used goal-setting to manage month-to-month tasks. At the end of each meeting Nora would summarize tasks and goals for subsequent meetings.

Inquiry into Digital Video. In addition to leading the inquiry group, Nora also adopted her own inquiry, namely to learn iMovie because she explained, "I want kids to learn to use it [iMovie], but I want to create a video that shows what our middle school program is about. And

we have some kids lined up to help us do that" (September 18, 2002). Nora made some progress toward her goal, but she did not actually learn the program by year's end. The main constraint was getting the technology set up in her office. In September, she intended to develop a portable video editing station, using her laptop as the computer. Later, though a more powerful computer was available, and it was set up and available in February in her room; however, it was on a portable cart that was so tall that she could barely see the monitor. By May, she had the technology transferred onto a movable desk and she met with Joan in June to begin learning the basic setup of all the multimedia and iMovie.

Holly: A case of pioneering integration and technology vision

Halverson School has framed Holly's education career. Not only did she complete her student teaching here, but she also immediately secured a summer and full-time humanities position at Halverson. In her fourth year as a teacher, Holly has been instrumental in developing Halverson's middle school program. Holly's classroom provides students the opportunity to share their classroom accomplishments and to learn. The walls are adorned with students' projects, maps, word collages about different events and time periods, directions for writing, and classroom rules. There are two computers in Holly's class, and Holly explained that the computers mainly were used for word-processing, Internet searches for class resources, and educational games. Additionally, she tries to familiarize her students with interactive websites that will enhance students' learning experiences.

Rooted in the curriculum. Holly's participation in the inquiry group is focused around her curriculum because she is committed to helping her students understand the basics of a particular topic as well as pertinent cross-curricular connections. For example, in one inquiry group meeting the teachers discussed their curriculum and identified geography topics that were lacking in their humanities curriculum. Nora wondered about a technology tool for geography and Holly offers insight into what she feels would be a worthwhile geography software tool:

> And it's not, I'd like to figure out a way to kind of imbed it into what we're doing, so it's not like okay now we're doing geography…. I'd like to see like right now, if I'm doing Civil Rights, I'd like to see a unit on geography that talks about immigration in the early 1900's and where people went and to what cities. I don't know, I guess things that would be more applicable to the unit I'm studying…. And then, you know, they have a lot of course during the Civil War, but things more about the Underground Railroad, like maybe a more interactive geography, something on [the route]… that's not just like a map with all these lines. (4/02 Meeting)

It is not enough for Holly's students to know the basics of the Civil War. She wants her students to have a multi-dimensional understanding of other factors that shaped the events of the time period. Holly examines her curriculum, her desired student learning outcomes, and methods in which technology could be most helpful in helping her students achieve this learning goal.

Pioneering Technology Integration. Holly's inclination to extend students' learning experiences led her to initiate the first learning and use cycle of all inquiry group members when she noted her interest in the AlphaSmart technology that was demonstrated by university participants. She was willing to learn and use new technologies with her students even though she had limited technology knowledge or experience, as well as to participate with colleagues in discussing curriculum through which problems of practice were identified. In October 2002, the university participants met with Holly individually and taught her how to use the AlphaSmarts and connect the AlphaSmarts to the computer to download students' work, introduced Holly's

students to the technology, and visited the classroom while students used the AlphaSmarts for writing workshop activities.

During the subsequent inquiry group meeting, Holly reflected about the students' use of the AlphaSmarts and stated, "there have been absolutely completely silent days, which is amazing for those kids…they are not really like that normally" (Transcript, 12/02). The students were silently and diligently writing! This observation launched Frank's interest in this technology. Holly used her insight of success and challenges of the AlphaSmarts to help Frank plan and execute his own technology inquiry of AlphaSmarts (see the case, *Frank* below). In addition, Holly thought deeply about how the AlphaSmarts might be used in different settings with different types of students. Specifically, Holly was interested in using the AlphaSmarts to motivate students with differing interests and experience with writing:

> Holly: I have a question about something I just kind of thought about that I could use those AlphaSmarts for in February. We're doing our project with artist empty bowls and what goes along with that is a big writing piece that, that would be used with all three of my blocks of 6th graders….Now these [students] are a lot lower skilled. Most of them are functioning at a 3rd or 4th grade level as far as writing and reading. But that might be just what the doctor ordered for them to write these pieces on homelessness …
>
> Frank: They'd probably really go for it.
>
> Holly: I think they would. I think that would be the opposite end of trying to get those students who are really resistant to writing. A lot of them are to feel a little bit more inspired. Certain files for certain kids…So it would be kicking it up a notch just a little bit. (12/02 Meeting)

Holly continued her pioneering spirit by continually identifying innovative ideas in an effort to improve her students' achievement.

She also used the AlphaSmarts to support students' essay writing, some of which were submitted to a local essay contest. Three students in the class won prizes for their essays. Holly was very excited about this outcome and shared it at a group meeting to which she received praise and congratulations from group members. Though Joan cautioned, "Well that's a nice result. We can't directly relate it to using Alpha Smarts," Holly emphatically responded, "Oh, but I mean they were so excited about working on those things" (12/02 Meeting). Holly believed that the technology had a great influence on the students' writing success.

An emerging leader. In addition to distinguishing curricular needs in the humanities and engaging in her own technology inquiry, Holly also assumed a degree of leadership within the inquiry group. Holly was responsible for logging their inquiry group's activities for the school and district. This involved taking notes during each meeting and compiling them. Holly also kept the group focused and prepared for the meetings. She often reminded the group of various required meetings and workshops that could conflict with inquiry group activities. Finally, Holly also occasionally summarized tasks for subsequent meetings. Holly's leadership activities ensure, at the very least, that she is prepared for inquiry activities but also helps make her colleagues aware as well.

We believe Holly was a pioneer and emerging leader within the inquiry group. Although the inquiry groups were district mandated, Holly truly desired to participate in the goals and ideals of the inquiry group. She works to keep the group centered on improving the curriculum through technology and models such improvement through her technology inquiry on writing workshop and AlphaSmarts. As a result of Holly's initiative, other inquiry group members

followed her example and also integrated technology into their classrooms. There were times when the thought of integrating technology seemed overwhelming. However, Holly was not motivated by fear, instead she was motivated by the success of her students. Her main goal was to see her student excel academically.

Frank: A case of collaboratively inspired technology learning

Frank, a humanities teacher with nine year's experience, has been teaching at Halverson for five years, and like Holly, has been integral in the 7th and 8th grade expansion to create a middle school at Halverson. Frank's classroom offers students many opportunities to participate in hands-on activities intended to relate their everyday life experiences. At the start of the inquiry group project, Frank's primary use of technology was the overhead projector. His classroom is equipped with two computers, and they are primarily used for student writing activities. At rare times when Frank's lesson required more than two computers, he would either use the computer lab in the media center or Cory's (another inquiry group member) classroom area that held seven computers.

Neophyte to Inquirer. At the initiation of the inquiry group, Frank proclaimed that he had not integrated educational technologies into his teaching. Frank appeared reticent to engage in a technology inquiry, as his attendance at meetings was inconsistent (see Table 2), and he was the least verbal participant at meetings. However, Frank's interest in teaching and the humanities curriculum was demonstrable. In fact, his participation flourished during meetings when the topic turned to humanities curriculum.

A turning point occurred during the November 2002 inquiry group meeting when Holly, another humanities teacher, shared progress of her technology inquiry on the use of AlphaSmarts for writing activities. Her enthusiasm about her students' writing with AlphaSmarts instigated Frank's immediate interest, and he began asking Holly questions, such as, "What are you doing with them?" and "What did you notice as far as just their motivation?" culminating with an inquiry statement, "I'm wondering if something like that might be a nice motivation for the eighth graders with the essays that they need to write." This became Frank's inquiry, and he began learning and using Alpha Smarts in his class that very month, with assistance from the university participants. Interestingly, demonstrations of AlphaSmart technology to the inquiry group by the university participants had not sparked a response from Frank. Yet, his close colleagues reflections on her use of them were crucial in kindling Frank's curricular and pedagogical interests in this technology.

Collaboratively-Developed Integration Plan. Once Frank had stated his inquiry in November, his participation became more consistent (see Table 2). Interestingly, the inquiry group, especially Holly and Cory, collaborated with Frank in planning his integration of the AlphaSmarts in his writing activities.

At first, the group discussed logistical issues, such as how to coordinate students sharing the keyboards across classes, and determining the schedule, specifically when the students' preparatory work would be completed and be ready to use the keyboards. For example, Nora spoke at length about how she could help Frank with preparatory activities and concluded, "Well, I'm thinking if one group got started on a rough draft on Monday, some of those kids might be ready Tuesday to use something like this" (11/02 Meeting). Ultimately, Frank postponed his implementation until January, yet the group continued to co-develop his implementation plan.

In January, Frank explained to the group that the AlphaSmart keyboards would allow his students to "be a lot more free to express themselves. Pencil and paper can be more intimidating for them, and I think [AlphaSmarts] will just get them more engaged. … I will get them started with an outline and that sort of thing. They work from an outline straight on the [keyboard]" (January 2003 Meeting). He also noted that he had limited the ten-day Writers Workshop activity to only one of his classes because he was afraid that students might delete each others' files, "And I just don't want to go one step forward and then three steps back and have them frustrated and have them say, 'Forget it!'" (January 2003 Meeting). Holly acknowledged Frank's pedagogical choices and reinforced his choice to start with one class at a time:

> Well, you know, just realizing that I had a perfect scenario, which I did. I am not talking about the beginning part but really they totally took ownership of it, completely. And so, I think you are probably going to need a lot more guidance and direction with the class situation, which I will [also] need to do to when I am going to do it with my whole class. (Holly, January 2003 Meeting)

In her comment, Holly also recognized that Frank's upcoming use is more challenging than what she had accomplished with the AlphaSmarts up to that date.

Frank and Holly also redesigned an activity that Holly and Joan had used with Holly's students to introduce the AlphaSmarts. Students each had an AlphaSmart and were assembled into a group of four students. We then started a round-robin writing activity in which each student would write for a few minutes, then time would be called and they would pass their keyboard to the peer to the right. Time would start again and each student would continue the story in his or her new keyboard. While Holly recounts the results of the activity, Frank develops a more productive approach to the activity:

> Joan: [to Holly] What did you think about that activity at the beginning? Would you do it again?
>
> Holly: I don't think I would do it again. Just because they get a little inappropriate. It is hard to run them in. You know. It depends on who is in your group, but, you know. It is hard to
>
> Joan: Yes, when you give them free range they take advantage of it?
>
> Holly: Yes. Maybe if they had a topic that they had to keep with? That would be better. But there was lots of murder, and death…So, I don't know. I like the concept. I just think it needs some more parameters.
>
> Frank: Well, we can make that…..
>
> Holly: But they could do initials after each sentence.
>
> Frank: You know, I don't want to worry about that. There just have to be certain parameters.
>
> Holly: OK
>
> Frank: Kids have to respect that. Not a big deal.
>
> Frank: And I won't see that as a problem and we can assist them by letting them know that if you are number four, number five, this is going to have a conclusion somehow, so keep that in mind, so that there is a clear start and ending….
>
> Joan: It is a good way to introduce technology
>
> Frank: You bet. But I think a prompt would be the best way for them to start out.
>
> (January 2003 Meeting)

With the collaboration of colleagues, Frank's inquiry flourishes in its planning stages.

As Frank implements the AlphaSmarts into his Writing Workshop, he realizes that not all students are responding positively. In a subsequent inquiry group meeting, Frank shares with the group his adaptations that supported his students' preferred writing methods, "As soon as I heard them [complain], not all of them but a number of them, then no big deal, but we are going to come back to it. And that way you know it is not the forbidden tool" (February 2003 Meeting). Each month, Frank shared more changes he was making in order to best fit the students' needs and to best support their writing achievement. For example, in March he describes the development of a small group rotation between writing, reading, and computer-based reading activities. In April, he reports, "It has been working really really well, giving them time on their own" (April 2003 Meeting).

Frank may have joined the group as a technology neophyte but within one year, had developed into a discerning technology integrator and inquirer. Frank is distinguished by his focus on the curriculum and his confidence in his colleagues' recommendations and suggestions. He explained, "It was nice to hear what other people's ideas were. About using the different technologies and how we can use them in our development of further curriculum maps and those sorts of things" (Interview 2, 5/03). Yet, he was not going to use technology without a compelling reason, "I've learned that I need to learn a whole lot more about how to use the computers and the different technologies appropriately. And also that sometimes the most simple technology of the alpha smarts, a simple word processor, gives kids a stronger motivation to work and to value their work" (Interview 2, 5/03). In this statement, Frank's vision for technology integration begins to be revealed.

Cross-Case Analysis

We have considered the teacher's learning at an individual level in the preceding section, but we also wanted to consider more specifically how the inquiry group approach might have impacted the teacher's varied accomplishments with technology integration. The individual cases illustrate varied success in learning and using technologies, and in this section, we will use a cross-case analysis to distinguish ways in which situative characteristics of the content-focused inquiry group model may have had positive or negative impact on teachers' technology learning accomplishments. As described in the introduction, Putnam and Borko (2000) describe a situative perspective on knowledge, thinking, and learning that involve three central concepts – "cognition is (a) situated in particular physical and social contexts; (b) social in nature; and (c) distributed across the individual, other persons, and tools" (p. 4). We use these theoretical characteristics to look across the individual teacher cases.

Cognition is Situated in Physical Contexts

In our approach to collaborative inquiry, the teacher learning was situated only in Halverson's K-8 physical plant. Specifically, most inquiry group meetings occurred in either Cory's classroom or Nora's office. Individual meetings between teachers or between university participants and teachers occurred in their school classrooms. The first author's original philosophy for these groups entailed that they be teacher-led and teacher-driven. Thus, situating meetings outside the school would be contradictory to this philosophy. Across the year, no inquiry group participants ever requested to engage in activities outside the school building.

This context was advantageous for learning because it allowed the teachers to have access to and use technologies at their school, in their classrooms. We were able to ensure that

software and hardware was functioning properly and set-up in locations of their choice. This context, however, was also a challenge, as the teachers were easily distracted from inquiry group activities to other school responsibilities. At times, the teachers missed the inquiry group meetings or had to leave early or arrive late due to Individual Evaluation Progress (IEP) meetings or other team meetings. Putnam and Borko (2000) warn that school-based professional learning occurring in a physical context where "patterns of thought and action have become automatic" (p. 6) possibly reduces teachers' inclination to change. Situating learning within a physical space that creates and supports concurrent, yet also, mandatory meetings is not conducive to focused learning. While these distractions occurred enough to remove participants from important conversations, it only dramatically affected Maureen's inquiry learning. Nevertheless, it raises the question of how can we best support school-based professional learning without succumbing to the everyday distractions.

Cognition is Situated in Social Contexts and is Social in Nature

The members of the inquiry group were part of several social contexts, including the middle school (all teachers), the humanities core (Cory, Holly, Frank), the new technology inquiry group (all teachers and university participants), and the research group (Joan, Ann, Shantia). All the learning that developed across the year was situated within the inquiry group but also within smaller dyadic social relationships that formed across or within this range of social contexts. In Table 3, we identify social relationships that impacted technology learning.

Teacher-teacher and teacher-university relationships emerged across the year. The most successful learning occurred between Holly – Frank, a teacher-teacher relationship, and Holly – Joan, a teacher-university relationship. One might assume that teacher-teacher relationships would be conducive to positive learning, as it was between Holly and Frank, but it is not a given. Maureen and Cory discussed and agreed to collaborate, yet no action was taken by either of them. They held the middle school as common but taught different disciplines while Holly and Frank both taught humanities. Teacher-university relationships were also successful and unsuccessful. Holly was eager to work with the university participants, and that relationship launched her into her inquiry, which, in turn, instigated Frank's inquiry. On the other hand, we wonder about the possibility that Cory perceived the university participants' "technology possibilities" (e.g., GIS software) not as a possibility but rather, as a prescription. Though we worked with him, we were continually mystified by his simultaneous interest and avoidance. In addition, his learning case revealed that Nora actually organized his second use of GIS. Taken together, we are considering the possibility that Cory felt required to pursue the GIS as an inquiry, which would explain his lack of investment in this inquiry because it was not a self-identified problem of practice. Maureen also requested assistance from the university participants, yet when she was given information and resources she never had the time to examine them and meet with the university participants.

Table 3
Social Relationships and Their Impact on Inquiry Projects

Participants & Social Relationship	**Characterization of Relationship**	**Learning Results**
Maureen – Cory (teacher – teacher)	"Empty Promise"	Agreement to take action; no action taken beyond discussion
Holly – Frank (teacher – teacher)	Teacher leading teacher	Frank fully embraces technology inquiry and uses technology with students
University – Cory Nora – Cory (teacher/univ – teacher)	Surface-level appears amicable and agreeable; Deeper: does Cory perceive it as "power relationship"	Agreement to engage in technology learning/use, but little action or investment by teacher
Holly – Joan (Teacher – university)	Scaffolding by MKO	Holly embraces technology inquiry with help; uses technology with her students
Cory – Joan (teacher – university)	Scaffolding by MKO	Scaffolding seems to hinder. Teacher invests little.
Maureen – Ann/Shantia (teacher – university)	Scaffolding by MKO	Assistance ignored. No action from teacher.

Cognition is Distributed across the Individual, Persons, Tools

The social relationships that developed, as described above, begin to reveal the distributed nature of learning across individuals and other persons. At the very least, the individual who seeks to inquire into issues of technology integration in a content area must have time and interest in the task. We saw how Maureen's lack of time prevented her from attending inquiry group meetings, prevented her from examining materials that were provided to her about her inquiry interests, and prevented her from acting upon her work with Cory. Yet, if the individual aims to learning within an inquiry group context, he/she also may need the right set of peers or colleagues with which to collaborate. Holly worked productively with both her school peers and the university peers, while Frank was more inspired into action by his school peer (Holly) than university peers. Finally, the individual and other persons need a set of tools to inspire, support, and track their inquiries.

One of the most important tools was the curriculum and the "problems of practice." Without identifying and accessing these tools, any investigation into technologies would be done without any guiding vision. Unfortunately, this inquiry group's initial focus on music and humanities shifted to a focus solely on humanities. When this occurred, Maureen's curriculum was eliminated and thus, when she did attend the inquiry group, she felt lost and unacknowledged. For an inquiry group interested in technology-supported learning, access to many technology tools that connect with curricular interests and problems of practice are also essential. As the first author argues elsewhere (Hughes, in press (b)), teachers need to have access to many technology tools during these inquiry tasks because the technology tools

themselves can create cognitive conflict, leading to problems of practice, or the tools are potential solutions to problems of practice identified through curriculum or lesson study. In our collaboration, we also had tools that were school resources, university resources, and resources on loan. The ownership of tools does not necessarily impact the learning that can occur, but it surely impacts the longevity of use if the school cannot secure the tool if it must be removed (e.g., a company requests return of tools on loan). Ultimately, the tools need to be available and they need to solve a problem. We suspect that Cory did not have an important "problem of practice" that the GIS software solved; thus, his learning inquiry was stunted. However, both Holly and Frank were intensely interested in motivating more of their students to engage in writing activities, and both enthusiastically engaged in learning and use the AlphaSmart technology.

Discussion and Implications

From this research, we've developed some explanative theories surrounding the context of inquiry approaches to professional learning at a K-8 school site. First, overall teachers did find success – they learned and integrated new technologies into their curriculum within one year. Holly and Frank were the most successful, with Cory, Nora, and Maureen less successful. Learning and integrating a new technology that appears to be a meaningful addition to student leaning activities are not easy tasks, and past research has shown it to take much longer than a year (Sandholtz et al., 1997). Most significant is the role that others played in Holly and Frank's learning. They would not have been successful in integrating technology had they not been part of the inquiry group. The university participants were crucial in scaffolding Holly's early integration of the AlphaSmarts into her class after which she began to plan new uses independently. Holly was then crucial in Frank's learning path, including identifying a worthwhile technology and a significant curricular problem – writing.

This group did not appear able to meet anywhere but at the school site. Despite occasional scheduling conflicts overlapping the inquiry group meetings, most teachers met regularly with each other and met in small groups or dyads in the intervening month. Again, with this group, the on-site physical context appeared crucial in supplying the necessary and functioning tools at just the right time. If the meeting had occurred off-site, such as the university computer laboratory, we suspect Holly and Frank would not have been as successful. In this year's inquiries, they chose to use university resources or resources on loan to the university. Thus, they required some investment of time to make sure they were on-site, functioning, and had requisite software installed on classroom computers. This is a time investment and a task that required technical knowledge that exceeded Holly or Frank's comfort zones. By situating the learning at the school site, we had to accept some interruptions and absences in order to have a comfortable zone conducive to experimentation and learning.

Cory and Maureen's experiences in the group underscore the need for teacher-identified focus. We suspect that Cory pursued learning and using GIS without a curricular problem of practice in mind, perhaps because he felt (unintended) pressure from Joan or Nora. He did use the GIS software but without much planning or focus. Maureen decided to leave the inquiry group at year's end, unfortunately yet understandable. The teachers began the group with a focus on arts-humanities integration but as the arts drifted away from focus (both due to Maureen's absences as well as more participation from teachers in the humanities), Maureen felt left out when she did attend the meetings. In future inquiry groups, we would encourage the

group to write individual and group goal statements, as these can be used over time as a guide. Despite Maureen's frustration with the group's drift toward a sole focus on humanities, the reality was that Maureen did not have any time for her inquiries due to her competing responsibility to prepare and complete her National Board Certification.

Part of our inquiry group project's goals was to also capture impact of inquiry learning by examining impact on student learning. To date, we have found this very difficult to do for several reasons. The time between when the teacher identified a promising technology and their initial attempts to implement it in the classroom were very short. For example, Frank wanted to pursue using AlphaSmart technology and within one month, he was using them in his classroom. This does not allow enough time for the researchers to identify or develop instruments to assess student learning and get them approved by the university and school district's Institutional Review Boards (IRB). However, we are thinking about this challenge in a new, more positive way.

The inquiry group learning that teachers engage in within the group as we have developed it encourages them to explore many technologies in order to, ultimately, find one or two or as many technologies as they see fit and complement their curricular practice and solve challenging problems of practice within their teaching. Such investigative work takes time and teachers will not necessarily adopt the first technology they try in their classrooms. It is for this reason that we believe it might be premature to begin trying to capture impact on student learning when teachers are only experimenting with new technologies in their classrooms. Once it appears a teacher has adopted a new technology for any length of period or for a unit of curriculum, it is at that point that developing some student learning measures is applicable.

We also see a role for the teacher in these assessments of student learning. With the push from NCLB for data-driven decision making, we would like to eventually include an action-research component in the inquiry group process, so that teachers may become more adept at examining current data they can garner from their schools as well as collect new data that will allow them to make data-based judgments about the impact the technology has on students' learning.

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[i] All school and participant names are pseudonyms.