

Technology Integration and Innovative Teaching Through  
Collaboration, Reflection and Modeling: Research Results from  
Implementation of a Staff Development Model

Eva M. Ross  
MAIT-Professional Studies Division  
Richard Stockton College of New Jersey  
P.O. Box 195  
Pomona, NJ 08205-0195  
United States  
rosseva@hotmail.com

Tristan E. Johnson  
Learning Systems Institute  
Florida State University  
C-4600 University Center  
Tallahassee, FL 32306-2540  
United States  
tjohnson@lsi.fsu.edu

Peggy A. Ertmer  
Department of Curriculum and Instruction  
Beering Hall of Liberal Arts & Education  
100 North University Street  
West Lafayette, IN 47907-2067  
Purdue University  
United States  
pertmer@purdue.edu

***Abstract:** Thirteen K-12 teachers participated in a technology integration professional development course that included course components such as peer modeling, peer collaboration, and reflection in an authentic learning context. The study purpose was to explore how teachers' beliefs, practices, and self-efficacy changed in this learning environment. Preliminary results indicate evolving teacher beliefs and practices as related to these course components. Results also indicate a significant increase in teacher self-efficacy, based on pre- and post-course survey scores. Self-efficacy remained positive for key research participants through study completion in Spring 2002.*

# Technology Integration and Innovative Teaching Through Collaboration, Reflection and Modeling: Research Results from Implementation of a Staff Development Model

Eva M. Ross, Tristan E. Johnson, and Peggy A. Ertmer

## Introduction and Background

While literature shows that barriers and challenges to effective technology integration exist even among exemplary users (Becker, 1994), it may be possible to address some of these barriers through professional development strategies. For example, research suggests that peer modeling and reflection may be effective strategies to move teachers along the technology integration continuum (Bandura, 1997; Dwyer, 1996; Gilmore, 1995), including moving from a traditional to a constructivist (or integrated) approach to teaching (Grabe & Grabe, 1998). Peer modeling of effective teaching and technology integration strategies may result in increased teacher confidence and competence (Bandura, 1997; Gilmore, 1995; Pintrich & Schunk, 1996).

Further, providing models of exemplary technology-using teachers in a staff development setting may facilitate changes in teacher beliefs about technology integration through structured exploration of those beliefs (Ertmer, Gopalakrishnan, & Ross, 2000). Seeing other teachers similar to oneself in a successful technology integration capacity may cause one to examine and possibly revise beliefs about meaningful technology use.

A related professional development strategy is teacher collaboration, whereby teachers share ideas and strategies through discussion with computer-using peers (Dwyer, Ringstaff, & Sandholtz, 1991; Hadley & Sheingold, 1993). Research suggests that peers provide emotional and technical support in the classroom (Dwyer et al., 1991; Hadley & Sheingold, 1993) and are found in exemplary-user environments (Becker, 1994).

Embedding learning about technology use within authentic contexts, including active learning approaches such as problem-based learning may contribute toward using technology as a meaningful tool (Duffy & Jonassen, 1992, Torp & Sage, 1998). Learning in authentic contexts may contribute toward changed teacher practice and increased confidence with regard to technology use [Dwyer, 1996]. If such strategies are developed and implemented, we may increase the likelihood that teachers will use classroom technology to enhance the critical thinking and problem solving abilities of school children.

## Research Purpose

Thirteen K-12 teachers participated in a professional development course, which included components such as peer modeling (including a CD-ROM model of exemplary technology-using teachers), peer collaboration, and reflection. The research purpose was to explore how this staff development model facilitated changes in (1) teachers' beliefs about technology integration; (2) teachers' technology integration practices; and (3) teachers' self-efficacy beliefs for incorporating technology. This study explores how teacher beliefs, practices, and self-efficacy changed, given this professional development experience.

The study was guided by the following research questions:

1. How do teachers' beliefs about technology integration (e.g., role of the teacher, assessment) change using reflection, collaboration, and modeling in a staff development program?
2. How do teachers' technology integration practices (e.g., assessment strategies, curricular emphases) change using this staff development model?
3. How do teachers' self-efficacy beliefs about integrating technology change using this staff development model?

This paper will address preliminary results obtained from initial and post-course teacher interviews, course assignments, and a self-efficacy survey instrument.

## Methodology

### Participants

Thirteen participants in the technology integration professional development course comprised our purposive sample. Twelve teachers agreed to participate in the study at various levels of involvement. Five teachers participated in the study in a limited capacity, agreeing to share course assignments and complete surveys specific to self-efficacy for technology integration. One teacher agreed to participate in interviews, surveys and to share her course assignments. Six teachers agreed to participate in semi-structured interviews, observations and a self-efficacy survey, as well as share their course assignments.

The participants came from four private schools in a Catholic diocese in a Midwest city and represented a range of grade levels and content taught. School demographics of the course participants are provided in Table 1. Teacher information, participant demographics and their classes as of Spring 2001 are provided in Table 2. Updated information for Fall 2001 is provided in Table 3, as some of the key research participants changed grades that term.

Table 1. School Demographics for Spring 2001 (Names are pseudonyms)

Name	Student Population	Ethnic Makeup	Grade Level
Hilltop	285	Approx. 4%	Pre-K to 3
Fairview	293	Approx. 9%	Pre-K to 6
Middleton	133	Approx. 4%	4-6
Elm Creek	375	Approx. 3%	7-12

Table 2. Demographics for Research Participants – Spring 2001 (Names are pseudonyms)

Teacher Name	Research Participation Level	School	Yrs Tchg	Teacher Degrees Obtained	Grade Level	Content Taught	Class Size	Classroom and Lab Computer Resources
Caroline	Extensive	Hilltop	23	M.S., Elementary Education	3rd	All subjects	Began with 22; ended with 19	Mac and PC available; 3 classroom computers; printers, digital camera, scanner
Clara	Extensive	Hilltop	9	B.S., Elementary Education and Language Arts	1st	All subjects	18	5 computers; scanner, printer, 2 IBM computers, 1 I-Mac, 2 Macs
Greta	Extensive	Hilltop	18	M.S., Education	2nd	All subjects	19	2 I-Macs, printer

Table 2 (Cont'd.). Demographics for Research Participants – Spring 2001 (Names are pseudonyms)

Teacher Name	Research Participation Level	School	Yrs Tchg	Teacher Degrees Obtained	Grade Level	Content Taught	Class Size	Classroom and Lab Computer Resources
Kathy	Extensive	Fairview	6	B.S., Elementary Education	3rd	All subjects	Began with 18; ended with 19	1 I-Mac, 1 Apple, 2-E-mates, printer
Eleanor	Extensive	Fairview	10	B.A., Elementary Education	4th	All subjects	26	2 Apples, 2 Macs, and a printer. Library: 2 I-Macs, approx. 10 E-Mates. Several people in building to ask for help.
Jennifer	Extensive	Elm Creek	15	B.S., Math.	7 <sup>th</sup> and 8 <sup>th</sup>	Math and Geometry	21	Computer, scanner, Fax, printer; access to computer lab
Julia	Extensive	Elm Creek	5	B.S., Home Economics	7 <sup>th</sup> and 8 <sup>th</sup>	Family Living; Clothing Construction	17-18 (Est.)	Access to computer lab
Amelia	Limited	Elm Creek	25	B.A., Social Studies Ed., M.A., U.S. History	9-11	U.S. History, World History	--	Access to computer lab.
Anne	Limited	Elm Creek	--	Masters, English Education	11-12	English Literature	--	Access to computer lab.
Ruth	Limited	Middleton	47	B.A., Elementary Ed., M.A., Elem. Admin.	4th	All subjects	--	2 I-Macs in class room; 28 Macs in computer lab
Martha	Limited	Middleton	13	Masters, Admin. and Supervision	Principal (18 yrs)	--	NA	I-Macs; access to computer lab
Sarah	Limited	Middleton	--	B.S., Elementary Ed., B.S. in Special Ed.	5 <sup>th</sup>	All subjects	--	2 I-Macs in classroom; access to computer lab.

Table 3. Demographics for Key Research Participants – Fall 2001 through Spring 2002 (Names are pseudonyms)

Teacher Name	Research Participation Level	School	Grade Level	Content Taught
Caroline	Extensive	Hilltop	3 <sup>rd</sup>	All subjects
Clara	Extensive	Hilltop	2 <sup>nd</sup>	All subjects
Greta	Extensive	Hilltop	Kindergarten	All subjects
Kathy	Extensive	Fairview	3 <sup>rd</sup>	All subjects
Eleanor	Extensive	Fairview	4th	All subjects
Jennifer	Extensive	Elm Creek	7 <sup>th</sup> and 8 <sup>th</sup>	Math and Geometry
Julia	Extensive	Elm Creek	7 <sup>th</sup> and 8 <sup>th</sup>	Family Living; Clothing Construction

## Research Design

The study was primarily qualitative, using a case study methodology. Quantitative and qualitative data were gathered specific to self-efficacy about classroom technology use. The qualitative data were gathered to explore and describe teacher beliefs about technology integration, changes in technology goals and teaching practices, and teachers' self-efficacy beliefs with regard to technology use. Quantitative data were also gathered to examine teachers' levels of self-efficacy with regard to classroom technology use. Data collection continued during the Fall 2001 and Spring 2002 semesters to allow time for changes in beliefs, perceptions, and practices to emerge.

## Procedure

The Spring 2001 semester-long professional development course was conducted once a week in three-hour sessions. Using electronic and peer models of technology integration, the course was designed to facilitate discussion about technology integration issues and to identify different strategies that might be used in the teachers' classrooms.

The course components included (1) presentation of information on problem-based learning (PBL), (2) a series of facilitated discussions, (3) presentation of the electronic models with related discussions, (4) course readings, and (5) the collaborative development of a technology-based PBL unit. The teachers also were asked to submit reflections on the various parts of the technology-based PBL unit.

## Instruments

Primary data sources included initial and post-course teacher interviews, observations of teacher classrooms, surveys, course discussions, and course assignments. Initial and post-course interviews were conducted to learn about changing teacher visions, beliefs (e.g., teachers' views about classroom organization and management, assessment) and practices specific to technology integration, as well as changes in self-efficacy. The first interview was conducted in February 2001, approximately one month after course outset; the second interview was conducted in June 2001, the week following the end of the course. A third interview was conducted mid-term Fall 2001 and two interviews were conducted in Spring 2002 (early in the term and the week following term end) to continue to explore evolving teacher beliefs and visions, classroom practices, and changes in self-efficacy.

Course observations were conducted to observe class activities and teacher discussions. In addition, classroom observations of key participants were conducted on a weekly basis to observe teacher classroom practices and technology use through Fall 2001. Because five out of the seven key participants opted to implement their technology unit in Spring 2002, biweekly observations were also conducted during that time.

Teachers completed a pre- and post-course online survey relative to teacher confidence (self-efficacy); this survey was also administered mid-term Fall 2001 and late Spring term 2002. This survey instrument, specific to teacher confidence about their technology integration practices (self-efficacy), was an adaptation of an instrument developed and tested in Fall 2000 (Ertmer, Conklin, Lewandowski, Osika, Selo, & Wignall, in press). The constructed instrument had three categories (planning for classroom technology use, implementing classroom technology, and assessing classroom technology use and impact), with 10 items each, for a total of 30 items. The instrument, based on a five-point scale, required responses ranging from "Very confident" to "Not at all confident." Item examples follow:

Relative to *planning* for technology use, I am confident that I can:

- 1) define teacher/student roles in a technology-integrated classroom.
- 2) plan classroom activities that facilitate technology integration.
- 3) plan for the use of computers with large-group instruction.

Course assignments included teachers' visions of themselves as technology-integrating teachers (at course outset and course end), development of a technology-based PBL unit for their classrooms and accompanying

reflections. During the class sessions, teachers engaged in group discussions specific to teacher ideas about what they were seeing and how that tied in with their views and goals.

### Quantitative Data Analysis

Data were analyzed for the 12 course participants, based on pre- and post-course (June 2001) self-efficacy survey results. A repeated measures analysis of variance was also conducted post-course for study participants at different times through Spring 2002 for said instrument. Reliability was also measured, using Cronbach's alpha.

### Qualitative Data Analysis

Interview data (pre- and post-course) for the seven key participants and pre- and post-course descriptions of technology visions (all 12 course participants) were analyzed and coded inductively specific to teacher beliefs, practices, and self-efficacy, using cross-case and within-case analyses. Examples of codes include "Contributors to Learning," "Technology Practice," and "Contributors to Confidence." This coding was done using Atlas.ti®, a qualitative analysis software package produced by Scientific Software Development.

## Results and Discussion

### Quantitative Data Results

At course outset (January 2001), teacher self-efficacy scores averaged from 1.1 to 3.0, with an overall mean of 2.2 (using a five-point scale, ranging from "Very confident" to "Not at all confident"), with a standard deviation of 0.67. At course end (June 2001), individual teacher scores on this instrument averaged from 1.2 to 4.9, with an overall mean score of 3.4 and standard deviation of 1.0. Using a repeated measures analysis of variance on pre- and post-course data (n=12), an F-value of 44.31 was obtained, significant at 0.0001.

Teacher self efficacy scores remained constant mid-Fall term 2001 (n=11), with a score range averaging 1.2 to 4.9, an overall mean score of 3.4, with a standard deviation of 1.2. A repeated measures analysis of variance between June 2001 and mid-Fall term 2001 showed an F-value of 0.07, which was not significant at 0.0001. Data collected from key research participants at the end of Spring term, June 2002 (n=7) showed a mean score range of 3.0 to 5.0, with a mean of 4.2 and a standard deviation of 0.87. Repeated measures analysis of variance, comparing mid-Fall term 2001 and June 2002 showed an F-value of 9.96, which was not significant at 0.0001. Instrument reliability, determined using Cronbach's alpha, was 0.99 for the self-efficacy instrument, averaging across all data collection points.

These results indicate that teacher confidence steadily increased from the initial course through June 2002 for key research participants. While the changes were not significant at 0.0001, the self-efficacy scores remained positive, with mean scores increasing in a positive direction, perhaps indicating the effect of successful implementation of teacher technology units developed in the Spring 2001 course.

### Qualitative Data Results

Preliminary data analysis, based on all interviews and descriptions of teacher technology visions, suggests the following themes:

- Contributors to learning (including components of the staff development model) viewed as useful varied with individual teachers, although, the more "active" types of learning—peer models and collaboration, hands-on experiences working on the PBL technology unit, and class discussions were mentioned most often as contributors. Teacher implementation of the technology unit was also perceived as a contributor to learning.
- Overall, at course end, teachers reported an increase in confidence with regard to technology use. Contributors to this increased confidence included knowledge increase, hands-on experience, peer support, and feelings of accomplishment. Confidence indicators included experimentation (willingness

to experiment with technology in the classroom) and increased student technology use. Implementation of the technology unit also contributed to teacher confidence, as did student motivation and enthusiasm.

- There are indications of some teachers' revising their beliefs with regard to technology. Teachers indicated a new awareness of and appreciation for the role of the student, the role of technology, and the role of the teacher in facilitating learning through technology use. Contributors to revised beliefs included a new appreciation for what the student could accomplish.
- Teacher technology practices included increased student technology use, including using their students to teach them. Teachers still expressed concern about assessment, classroom management and classroom organization with regard to technology use. By Spring 2002, teachers were indicating that their technology practices were becoming aligned with their vision for technology use.

#### Contributors to Learning: Consideration of the Staff Development Model

Course components valued as learning contributors varied with individual teachers. The strongest contributors to learning, based on post-course interviews with those teachers who participated extensively in the research, appeared to be peer collaboration and peer models, hands-on experiences, and class discussions. Course reflections also led to new insights about teaching.

Clara, Greta and Caroline, all teachers at Hilltop Elementary in grades 1-3, respectively, collaborated together on their technology-based PBL unit. Of the contributors to their learning, Clara and Greta both mentioned peer collaboration as being valuable. According to Clara:

I think the biggest thing was the peer collaboration, because Caroline was so wise, in--in her knowledge...where Greta and I were lacking...even the confidence...So that, and feeling that we had someone that did know part of what was going on; and it was neat working with Caroline because we found out she didn't know everything. And some of the things we learned together. [Post-Course Interview, June 6, 2001]

Greta also appreciated the support that Caroline gave to her. Further, it appears that Caroline (who acted as an informal technology coordinator for the school) acted as a peer model for Greta: "...I think Caroline was such an awesome...leader for us. She gave us a lot of—but, at the same time, a lot of the things she did—we just watched...And so, I'm hoping that I can take what I saw her doing and try and do myself." [Post-Course Interview, June 4, 6, 2001]

At Fairview, Kathy (a third grade teacher) and Eleanor (a fourth-grade teacher) also collaborated together on their project. Kathy found working with Eleanor helpful, as well as the class discussions: "Well, definitely the class discussions, especially the one that we had on the security issues and privacy...I liked that one a lot....And working with Eleanor helped a lot...She --she'd always have so many great ideas--I love working with her." [Post-Course Interview, June 6, 2001]

Eleanor found the hands-on experiences of the project most useful: "...All of that contributed. And, but actually doing it....The hands-on was the most--yeah, for me..." [Post-Course Interview, June 7, 2001]

Through course reflections, Julia (a 7<sup>th</sup> and 8<sup>th</sup> grade teacher) expressed a new insight the importance of using active learning approaches in her classroom: "What better way to teach my students skills for life than to engage them early in PBL! Could I really teach them anything more important? [Technology Vision Revisited, April 24, 2001]

It is interesting to note that these teachers overall selected more "active" methods of learning—hands-on experiences, working with others, participating in class discussions. While these components were mentioned frequently, it should also be noted that reflections and course readings were also mentioned as learning contributors. It is also possible that the electronic peer models (which were used in the course a couple of times) might have been a stronger contributor with more use.

The technology unit developed in the course was implemented by six of the seven key participants. Julia at Elm Creek implemented her unit in Fall 2001; Jennifer opted not to do so. The remaining key participants at Fairview and Hilltop spent Fall 2001 preparing their students for the upcoming unit and other class projects through skill-building activities, such as teaching their students PowerPoint and KidPix. Students also developed keyboarding skills. These teacher technology units were implemented, to varying degrees, during Spring 2002. The implementation of these technology units appeared to act as a catalyst for learning for some of the teachers--they learned by "just doing it." [Clara, Post-Course Interview, June 12, 27, 2002]

Many teachers learned by watching their students in action. When asked about learning contributors, Eleanor responded:

The kids...and then just doing it. You have the idea, and you learn so much just by doing it. And the kids help...the checklists, I thought, was very helpful. They knew exactly what to do, and--and they even filled out the eval--evaluation of each other, without me even having to remind them again, and so I learned that that worked really well. [Post-Course Interview, June 11, 2002]

Kathy learned more about planning and classroom management with technology:

I--I don't know that I learned it, but I had to remember that you need to be flexible...And we learned that with our project; we tried the four in a group and it did not work. There is not enough work for four people in a group. So I learned that...maybe it would be better to do a test run with our project with--before you actually start it with the kids, maybe would have been a good idea." [Post-Course Interview, June 11, 2002]

#### Increased Confidence, Confidence Contributors and Indicators

Post-course interviews and post-course teacher visions collected in June 2001 indicated increases in confidence for six out of seven key participants with regard to classroom technology use. Contributors to this increased confidence included knowledge increase, hands-on experience, support, and feelings of accomplishment, as well as the opportunity (and willingness) to experiment with technology in the classroom.

For Kathy, the third grade teacher at Fairview, an increase in knowledge also related to her confidence in classroom technology use, as well as willingness to ask for support.

I still believe that technology is a wonderful and exciting way to teach and motivate students. I feel somewhat less overwhelmed by the amount of information and software available. I have more confidence in myself and my abilities to utilize technology. In addition, I no longer feel embarrassed to ask for help when I need it. [Technology Vision Revisited, April 24, 2001]

Peer support and accomplishment continued to contribute to confidence, as well as hands-on experience. Greta found that working with Clara and Caroline helped her confidence and her learning, as did the hands-on experience. When asked about confidence contributors, Greta answered: "Doing it with Caroline...just getting that whole page together...turned out marvelously because of Caroline, I think...cause having her in the group, that made me be able to say, 'Yeah, I can do that,' or 'How did you do it, Caroline?'...Trying to get so that I would learn from her." [Post-Course Interview, June 4, 6, 2001]

Kathy believed that changes in her classroom could be attributed to her increased confidence and hands-on experience, which led to her increased technology use and experimentation: "I guess, mainly my confidence has gone up, so that created a change. And that started with the discussions and...actually getting in and using the computers, and finding new things to do with the computers myself." [Post-Course Interview, June 6, 2001]

As their technology journey continued, teacher confidence with regard to technology use increased overall, due in part to hands-on experiences, support, increased knowledge, and feelings of accomplishment. Indicators of such confidence were reflected in their encouragement of and confidence in increased student computer use and

willingness to experiment with technology. The chance to implement the technology unit also contributed to increased confidence, as Eleanor explains:

Oh, it's--it's--it's definitely increased, because once you see something that you planned and you're implementing it--and it could be--it may be a struggle--a struggle planning it and a struggle implementing it, but when you finally get it done, that does--that increases your confidence big time, I think. And, well now, you can see, I've got so much more ideas on technology, and with the Power Point, I thought...it's taking it step by step, but now, who knows? [Post-Course Interview, June 11, 2002]

Contributors to teacher confidence included the students' overall excitement and motivation in using the technology, as well as relying upon the existing support structure. When asked about her confidence in implementing her goals and plans, Kathy responded: "Well, I guess I've learned that you don't have to know everything in order to do it. That you can draw on other people's knowledge and things as you go sometimes." [Post-Course Interview, June 11, 2002] Further, specific to confidence contributors, Kathy said: "Just the success that we've had...and the--the motivation for the students, and their enjoyment of it." [Post-Course Interview, February 11, 2002]

Confidence was indicated at the end of Spring term 2002 through increased technology use, an increase in planned technology use, new ideas and strategies, and the expressed desire by all five teachers to use the technology unit again in the future.

Both Clara and Greta, who initially felt a lack of confidence, saw a difference by Spring term 2002, in terms of their confidence in implementing goals and plans.

Well, I know when I started the class I had--when I started the class, Greta [pseudonym] and I were just...when we walked out of the room the first time, and to see the growth from there to here...like my confidence in doing it, and the ideas that come from it. So...I just see a lot of growth in it. [Clara, Post-Course Interview, June 12, 27, 2002]

Oh, see that--I wouldn't have probably been willing to take them [the students] up to the Lab by myself. And--and have them all on the computer and think, "Oh my gosh," but we--I did that and found out that it worked and so we went more. [Greta, Post-Course Interview, June 21, 2002]

### Changing Teacher Beliefs

For some teachers, existing beliefs about technology changed or were enhanced with regard to technology use. Clara learned early in the term that technology could be used as a tool, rather than her earlier conceptions of how she should use it in the classroom.

I've learned, mainly, that technology is a tool; and I think before I thought, in reading these things and really thinking about it, I was thinking technology more as a subject?...And that--I teach across curriculums...I was looking at technology as another subject area, rather than seeing it as a tool that enhances subjects areas I already have, so that's where my whole thinking has changed, and I can see now that this can be a really great, effective way to teach some of the--my areas to enhance them... [Initial Interview, February 5, 2001]

Although her beliefs about the value of technology had not changed, at course end Jennifer, a 7<sup>th</sup> grade Math teacher, spoke of revising or revisiting her beliefs about the role of the teacher, specifically teacher-directed learning in the classroom:

As a result of developing my problem-based unit, I have learned, or been reminded, that technology makes learning more student-centered. I think I would be very naive, even wrong, to believe that all students learn best in a teacher-centered classroom. I have found myself asking "Do the students really need me to show them how to solve a linear equation (any math concept for that matter) or could they discover this on their own?" [Technology Vision Revisited, April 24, 2001]

As of the end of Spring term 2002, teacher beliefs included a awareness of and appreciation for the role of the student, the teacher, and technology in facilitating technology use. As Kathy stated, "I'm the guide...I don't like to be the one--especially in computers, where so often sometimes the kids know more than you do. I don't like to try to get up there and pretend like "Oh, I'm--I'm the one who knows everything... let me do this for you...And I guess the role of the child is just to be a learner--and a leader sometimes..." [Post-Course Interview June 11, 2002]

Kathy's new appreciation of what her students could do contributed to her changed beliefs. "The kids finding so many things on the KidPix, I think--have helped to change my ideas about what they're capable of and what's--what's available out there, and what they can do with it, I guess...To let them just take it on their own and go with it. They just really surprised me with how much they were able to do." [Post-Course Interview, June 11, 2002]

Eleanor indicated a renewed appreciation for what the students could accomplish: "It was a problem-solving process for the kids, also, but I was amazed at how much they took over, which is--is great, because that's what I like about teaching is that...you don't plan to go in and tell 'em, 'See, this is--this what I know, and this is what I want you to do.'" [Post-Course Interview, June 11, 2002]

Teacher beliefs are not easily changed, and traditional roles in the classroom can be hard to overcome (Ertmer et al., 2000; Fullan, 1993; Schrum, 1999; Van Haneghan & Stofflett, 1995). As Schrum stated, "Teachers need compelling reasons to change their practice" (1999, p. 85). In the above examples, it appears that the components of the model may be helping some teachers consider and possibly revise their beliefs with regard to classroom technology integration.

### Teacher Technology Practices

Perhaps due in part to their overall increased confidence with using technology in the classroom, many teachers tried out new ideas with regard to technology. In doing so, they addressed challenges such as classroom organization, management and assessment, as well as time constraints.

Clara described a successful use of technology for her, one that she had only tried out that term with her students: "Each one wrote a little paragraph about themselves...and then they had to find some Clip Art or something that looked...that showed--reflected them...and put it on their--their paper...and print it out. And we did get that done! So that was successful...I think because the children enjoyed it so much. They were able to follow the directions. They ended up with a good product...and they had fun." [Post-Course Interview, June 6, 2001]

Clara also had her students working on researching a dinosaur project on the Internet, using the students to help each other: "What I tried to do there is put someone that was more computer-literate, someone that could read well...with someone that was a little bit lower...so they could work. So sometimes, I didn't have as many high students, so sometimes the high student would work with three or four...students at different times." [Post-Course Interview, June 6, 2001]

Eleanor had her students teach her how to use KidPix, preparatory to using her technology unit, which she had developed with Kathy, the following term: In doing so, she and her students used KidPix to run ads on the VCR monitor during their Mini-Economy activity:

Planning our unit, we were planning on using KidPix and I had never done that before...so I did go ahead and look at it and then use it at the end of this year, so that I'll be more able to jump into the unit next year....That was a lot of fun. And here, a couple of my student experts helped me cause...they had it at home and helped me how to use it and, so I had no idea what I was going to do with the kids, but we ended up doing our ads with our Mini-Economy on there...with the--the music and the--the slide show and that--that was really cool. [Post-Course Interview, June 7, 2001]

While concerns about assessment and classroom management remained as issues at the end of Spring 2002, many teachers found that their ideas about technology use and their practice were coming closer together--teachers were moving closer to their technology vision, aligning more with their beliefs about teaching and technology.

Eleanor spoke early Fall term 2001 about her ideas for technology and how that tied in with practice:

We got the whole...National Weather Service up there, and we were actually watching a front come in and, sure enough, we watched it right out the window. We saw it come in, so, I mean, that—that's daily, everyday stuff, that you're bringing right into the classroom...it's more of a...it's something that is there now...which it—it's at reach, and before it wasn't. [Post-Course Interview, September 20, 2001]

When asked in Spring 2002 how her vision for technology compared to practice, Eleanor responded, "I think it's right with it...Actually, it's...It--it--it's intermingled...because I think maybe my vision isn't very lofty, but it's-- it's attainable and in sight." [Post-Course Interview, June 11, 2002]

Clara responded, "Well, I think they're probably lining up [vision to practice]...and running parallel to each other. Where--before, my vision was probably right on track, but what I was doing was kind of faltering... moving ahead slowly where my vision was." [Post-Course Interview, June 12, 27, 2002]

## Conclusions and Future Implications

### Impact of the Staff Development Model

It appears that the course components were (perhaps, not surprisingly) of value to different teachers in different ways. The hands-on experience, as part of the PBL technology unit, were mentioned often as being useful in terms of increased knowledge and confidence. Peer collaboration was particularly useful to those who looked to "leaders" to help them in skill building and developing web pages. Reflections were useful for "rethinking" where they were and where they are going. In some cases, reflections may have contributed, in part, to changing teacher beliefs. Implementing the technology unit contributed positively to teacher confidence, beliefs and practice.

Overall, the impact of the staff development model appeared helpful in terms of changing teacher confidence, beliefs and practices. Participants did not directly say, "This component helped me change my practice." However, in the sense that the various components contributed to increased knowledge and confidence, it may be termed useful. Pre-course profiles indicated that teachers varied from traditional teaching approaches toward more integrated approaches to classroom technology use (Grabe & Grabe, 1996). While further analysis is needed to confirm these initial results, this may lead to an interesting contrast relative to changes that may occur as a result of the professional development course, given the diversity of approaches.

### Further Data Analysis Needs

Analysis of interview data with seven teachers appears to indicate that their school cultures encourage collaboration and reflection, with some teachers also referring to other teacher "models." Given the existing culture, it will also be interesting to see how teacher beliefs and technology integration practices are facilitated by such cultures, in conjunction with (and supported by) the professional development model, which also encourages collaboration, reflection, and modeling. Further analysis of additional data sources is needed to confirm these impressions. Further analysis remains to be done on course data and observations. While preliminary data analysis has focused on teacher beliefs, practices, and self-efficacy, as well as learning contributors, results are yet to be determined in greater depth.

With regard to efficacy data analyzed to this point, results are somewhat consistent with those of Stein and Wang (1988). While many studies have examined teacher efficacy in professional development settings, often self-efficacy is measured at one point in time (Ross, 1995). However, research has shown that teacher efficacy may be curvilinear across time (Stein & Wang, 1988). According to Stein and Wang (1988), teacher self-efficacy may increase during a professional development course, then decrease as the teacher attempts to put what was learned into practice and then later increase again as the teacher masters what was learned. It may then be useful to measure teacher self-efficacy, not only during a professional development course, but also as a follow-up (as in the following term) in the teachers' classrooms. In this case, the teacher self-efficacy, specific to the key participants remained steady. This may be due, in part, to consistent researcher follow-up in Fall 2001, fading gradually through Spring 2002, until data collection ended after Spring term. It is possible that such follow-up aids teacher self-efficacy. Further research is needed to confirm this conclusion.

## References Cited

- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.
- Becker, H. J. (1994). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education*, 26, 291-321.
- Duffy, T. M., & Jonassen, D. H. (Eds.). (1992). *Constructivism and the technology of instruction: A conversation*. Hillsdale, NJ: Erlbaum.
- Dwyer, D. C. (1996). The imperative to change our schools. In C. Fisher, D. C. Dwyer & K. Yocam (Eds.), *Educational technology: Reflections on computing in classrooms* (pp. 15-33). San Francisco, CA: Jossey-Bass.
- Dwyer, D. C., Ringstaff, C., & Sandholtz, J. H. (1991). Changes in teachers' beliefs and practices in technology-rich classrooms. *Educational Leadership*, 48(8), 45-52.
- Ertmer, P. A., Conklin, D., Lewandowski, J., Osika, E., Selo, M., & Wignall, E. (In press). The effect of electronic models on teachers' self-efficacy for technology integration. *Teacher Education Quarterly*.
- Ertmer, P. A., Gopalakrishnan, S., & Ross, E. M. (2001). Technology-using teachers: Comparing perceptions of exemplary technology use to best practice. *Journal of Research on Technology in Education [On-line serial]* 33. Available: <http://www.iste.org/jrte/33/5/ertmer.html>.
- Ertmer, P. A., Gopalakrishnan, S., & Ross, E. (2000). *VisionQuest: Helping teachers achieve technology integration*: Paper presented at the Annual Meeting of the Society for Information Technology & Teacher Education, San Diego, CA.
- Fullan, M. (1993). *Change forces*. Bristol, PA: Falmer.
- Fogarty, R. (1997). *Problem-based learning and other curriculum models for the multiple intelligences classroom*. Arlington Heights, IL: IRI/Skylight Training and Publishing, Inc.
- Gilmore, A. M. (1995). Turning teachers on to computers: Evaluation of a teacher development program. *Journal of Research on Computing in Education*, 27, 251-269.
- Grabe, C., & Grabe, M. (1996). *Integrating technology for meaningful learning*. Boston, MA: Houghton Mifflin.
- Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. *American Journal of Education*, 101, 261-315.
- Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River, NJ: Merrill/Prentice-Hall.
- Pintrich, P. R., & Schunk, D. H. (1996). *Motivation in education: Theory, research, and application*. Englewood Cliffs, NJ: Prentice-Hall.
- Ross, J. A. (1995). Strategies for enhancing teachers' beliefs in their effectiveness: Research on a school improvement hypothesis. *Teachers College Record*, 97, 227-251.
- Shaw, D. E., Becker, H. J., Bransford, J. D., Davidson, J., Hawkins, J., & Malcom, S. (1997). *Report to the President on the use of technology to strengthen K-12 education in the United States*, [World Wide Web]. President's Committee of Advisors on Science and Technology - Panel on Educational Technology. Available <http://www.ostp.gov/PCAST/k-12ed.html> [1997, September].

- Schrum, L. (1999). Technology professional development for teachers. *Educational Technology Research and Development*, 47(4), 83-90.
- Stein, M. K., & Wang, M. C. (1988). Teacher development and school improvement: The process of teacher change. *Teaching & Teacher Education*, 4(2), 171-187.
- Torp, L., & Sage, S. (1998). *Problems as possibilities: Problem-Based Learning for K-12 education*. Alexandria, VA: Association for Supervision and Curriculum Development..
- Van Haneghan, J. P., & Stofflett, R. T. (1995). Implementing problem solving technology into classrooms: Four case studies of teachers. *Journal of Technology and Teacher Education*, 3(1), 57-80.