DOCUMENT RESUME

ED 411 237 SP 037 528

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TITLE	Students as Technology Experts: A "Bottom-Up" Approach to Teacher Technology Development.
PUB DATE	1997-03-00
NOTE	16p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, March 24-28, 1997).
PUB TYPE	Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*College School Cooperation; *Computer Literacy; Elementary Education; Elementary School Students; Elementary Schools; *Faculty Development; Graduate Students; Higher Education; Professional Development Schools; Student Motivation; *Student Role; Teacher Improvement; *Teacher Motivation; Teaching Skills
IDENTIFIERS	*Learning Communities; *Technology Integration

ABSTRACT

The intent of this "bottom-up" project was to create a community of learners to facilitate the implementation of computer technologies in the elementary school curriculum. The participants were 6 graduate students and their professor, 10 teachers (grades 1-5), their students, and the librarian in a Professional Development School. Each week on "Tech Days" the students received training for one-half hour, with the graduate students and the professor providing training in computer applications. Second semester, in addition to "Tech Day" instruction, some students received extra intensive training to enable them to serve as "experts" in the classroom environment. University team members were responsible for planning activities with the teachers and librarian and providing after-school sessions for teachers. Study findings revealed both benefits and limitations to this approach. Benefits included increased motivation for teachers to learn about and use technology in their classrooms, changes in the attitudes and motivation of the students, and more independence and confidence in using technology. Limitations focused on logistics (number of available computers, time problems, inadequate staffing and funding). As a result of this "bottom-up" approach, teachers became more for frequent users of technology, and they began to use their students' expertise to increase their own computer skills. (Contains 16 references.) (ND)

Students as technology experts: A "Bottom-Up" approach to teacher technology development

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Presented at the Annual Meeting of the
American Educational Research Association
Chicago, IL
March 1997

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An extensive study conducted by the Office of Technology Assessment (OTA, 1995) concluded that traditional methods of training teachers in technology skills (workshops, inservices, etc.) have been inadequate. As the Office of Technology Assessment reported, U. S. schools have 5.8 million computers available for instruction. Nevertheless, a substantial number of teachers still report little or no use of computers for instruction.

Although educational innovations continue to appear throughout history, innovations only become practice if change occurs. Change is a complex process involving the stages of initiation, implementation, and incorporation (Bennis, Benne, Chin, & Corey. 1976; Fullan & Hargreaves, 1992; Giacquinta, 1973; Herriott & Gross, 1979). However, initiation does not guarantee implementation (Giacquinta, 1973). It is often easier to focus on the "possibilities" that change will bring rather than on the real work of the implementation stage. In their discussion of impediments to educational change efforts, Herriott and Gross (1979, p. 26) reported "failure of officials to recognize the critical importance of the implementation stage of the change process and to identify and deal with obstacles that arise" as a critical barrier to change efforts.

Despite the key role that the implementation stage plays in change efforts, current methods of teacher training often fail to address this stage. Ringstaff and Yocam (1994, p. 31) stated that "current methods of professional development are woefully inadequate because most focus on learning about computers rather than on learning how to integrate computers into the curriculum." Although teachers may be shown the basic hardware components and be given time to investigate software, training for integration is often lacking.

Another obstacle to the use of computers in schools is the limited support teachers have for integrating unfamiliar technologies into instruction (Goldberg & Richards, 1995; Hancock & Betts, 1994; Kearsley & Lynch, 1992). Teachers often mention that "there is neither enough time to learn nor enough time to practice; thus, it is difficult to develop the level of expertise needed to incorporate technology into their jobs" (Heaton & Brown, 1995).

A body of literature is accumulating that suggests that changes in methods of staff development may help alleviate common barriers to computer integration (Ringstaff, Sandholtz & Dwyer, 1991; Ringstaff & Yocam , 1994; Ritchie & Wiburg, 1994). A small part of this literature advocates the use of students as an integral part of the technology training process. The Apple Classroom of Tomorrow (ACOT) project offers strong support for this approach and illustrates how using student technology expertise in the classroom may effectively address implementation barriers. For example, Ringstaff et al. (1991) stated that "while many teachers at first questioned the value of using students as teachers and wondered how it would affect learning, teachers soon realized that the benefits of this role shift went far beyond saving them time" (p. 12). Teachers saw change not only within their students but within themselves.

Teachers often took the role of facilitators, while students played the role of experts (Ringstaff & Yocam, 1994). Students provided ongoing assistance to their teachers. As the teachers became more confident with this pedagogical shift, learning to integrate technology became more relevant. "Only classroom practice (i.e., working with children) provides relevance and purpose to access skills and information and, therefore, has the potential for long-term changes in teacher behaviors" (Gilmore, 1995, p. 254).

Other obstacles to change may also be mitigated by this approach to staff development. If teachers see positive change in their students, they may be motivated by the innovation. "Users of technology need to be converted to a point of view; they need to believe that what they are being asked to do will work and that it is the best available solution to an identifiable educational problem" (Kearsley & Lynch, 1992, p. 52). Giacquinta (1973) adds "the greater the commitment or desire on the part of the school personnel to making change, the greater the change to be expected " (p. 184).

A student-based technology training program addresses the key components of the change process by creating a community of learners centered around teams of teacher/student learners. Effective "professional development requires a learning *community*, where responsibility is assumed and shared" (Goldberg & Richards, 1995, p. 13; italics added). In communities of learners, teachers and students relate to one another with respect; they participate in and take responsibility for the collective life of the school; they count on one another for meeting both individual and collective needs.

In a description of the key principles of learning communities, Lin et al. (1995) emphasize a focus on the social context of learning in order to facilitate the ability of participants "to think critically and reason about important content, plus the ability and motivation to learn independently throughout one's life" (p. 54). Within a collaborative, supportive social structure, the expected outcomes focus on increased motivation and the ability to learn independently. An emphasis on individual <u>self-directed learning</u> is balanced by the expectation that learners will work <u>collaboratively</u> to achieve the goals of the group. In a learning community, the expertise is distributed across participants; individuals are free to "specialize in particular areas so that the community can capitalize on diversity" (Lin et al., 1995, p. 54). Students develop mutual respect for each other as they take on leadership roles and assist each other within and across groups. "In a collegial school, adults and students are constantly learning because everyone is a staff developer for everyone else" (Barth, 1990, p. 513).

The OTA (1995) report on the Olympia Washington School District also supports involving students as key participants in technology training and staff development in order to develop a community of learners. The Olympia School District does not provide technology

workshops for teachers. Workshops are provided for students and they share this knowledge with administrators, teachers, and other students. Their director stated, "We have found that using students as technical resources pays better dividends than teachers depending on colleagues. Kids take to technology faster than teachers, are more readily available, and the children's self-esteem is enhanced by being a mentor to a teacher" (p. 70).

The purpose of this project was to design and implement an approach to technology integration that lessened or eliminated barriers to technology integration commonly cited in the literature. By creating a community of learners and distributing expertise across elementary students and their teachers, the following barriers were addressed (Gilmore, 1995; Hannafin & Savenye, 1993; Kearsley & Lynch, 1992; Ritchie & Wiburg, 1994):

1) time to practice and explore available technologies
2) ongoing assistance
3) changes in attitudes and pedagogical beliefs
4) shift in traditional teacher's role
5) fear and confidence levels
6) relevancy of training to instructional setting

By distributing the task of learning technologies across multiple participants in the learning community, the negative effect attributable to the first barrier (teachers' *limited time* for practicing and exploring available technologies) is lessened and/or eliminated. Other individuals in the learning community develop and share the expertise that they are lacking. Providing elementary students with expertise in using technologies provides teachers with *ongoing assistance* as they begin to use technologies in their classrooms, effectively addressing the second barrier. *Changes in the attitudes and pedagogical beliefs* of individual teachers are likely to occur within a larger supportive community. With students possessing expertise in technology use, the traditional *teacher's role* can shift from information provider to project manager when incorporating projects requiring the use of technology. Relieving the burden on teachers to be classroom technology experts allows them to focus on areas in which they have more expertise than their students. This also serves to alleviate *teachers' fear of technology*; when they observe that their students make mistakes yet still develop important skills, teachers' confidence levels also increases. They begin to believe that they too can master the skills required for technology integration. And finally, allowing the goals of the instruction to emerge in the context of an individual school and its specific needs insures the *relevancy of the training* to the instructional setting.

The purpose of this ongoing integration project is threefold: First, to develop a successful technology implementation program in an elementary school setting; second, to increase teachers' skills in technology use through creation of a collaborative community of

learners; third, to target the child as a technology leader in an effort to increase student and teachers' technology skills and use.

Methods

Participants

In this project, the community of learners consisted of individuals from both the university and public school environments. The university team consisted of six graduate students enrolled in a year-long research apprenticeship seminar and their professor. The school community, a local Professional Development School (PDS), consisted of ten teachers (2 teachers each in grades 1-5), their students, and the librarian. The school is one of 11 elementary schools in the corporation and serves students in grades kindergarten through five with a total enrollment of 274 students.

Initial efforts focused on the elementary students. During "Tech Days" students in grades one though five were trained in various technologies by university graduate students and faculty. There were two classes at each grade level; thus, ten classes received instruction in using technologies as tools for accessing information and tools for expression. All students received training in the library as a class for one half-hour session per week throughout the school year. Teachers were invited to attend each class session.

The university team met one hour each week to plan activities in the schools. The meetings were collaborative in nature, with decision-making distributed across the group. All members of the university team were responsible for conducting one or more half-hour sessions with the students each week. All university team members were involved in planning and presenting one after-school session for the teachers.

Every two weeks, the professor met with a team of three teachers and the librarian to plan technology implementation activities for the school. The Tech Days instructional sessions were conducted in the library in cooperation with the librarian. She participated in planning and conducting the sessions with varying degrees of responsibility throughout the year. The ten teachers of grades one through five were required to send their students to their Tech sessions, nothing more. The principal was aware of the Tech program from an administrative perspective, but did not participate in the day-to day decision making involved in the implementation of the program.

Activities

The first semester of the program involved hands-on training in a variety of computer applications. Learning stations introduced students to the Library Browser, ClarisWorks, CD ROM software, and XapShot cameras. Small groups of students circulated through one station each week. Each station provided students with a "take home" product. At the end of the semester, the university team offered teachers an optional after-school session designed to

provide ideas on incorporating students' new skills into classroom assignments. Although teachers' interest in technology training was low prior to beginning this project, 24 of the 25 staff members (12 teachers) choose to attend the optional after-school session.

During the second semester, interactions with student groups continued. In addition to our weekly "Tech Day" sessions with each class, eight students were selected to receive intensive training in computer technologies to enable them to serve as technology "experts" in the classroom environment. The university also scheduled a traditional introductory computer class at a nearby school for the convenience of teachers who wished to enroll for university course credit. No members of the university team were involved in the course beyond setting up the initial contact between the school and the course instructors.

During the first six weeks of the second semester, each class was assigned a project during "Tech Days" which allowed them to integrate and apply the skills they learned during the first semester. Classes searched the library browser to locate books and searched CD-ROM resources to collect information. They typed reports using the word processor, created illustrations with drawing and paint programs, captured graphics from electronic sources, and created XapShot images. Student groups created projects on a variety of topics such as dinosaurs, fairy tales, and the fifty states.

After the student groups completed their projects, the university team introduced them to hypermedia in order to provide another means for presenting information. Using HyperStudio, students learned to create cards, buttons, and links incorporating text, graphics, and sound.

Data collection

Although our observations suggested that the Tech Day program had a positive effect on the technology skills of students and teachers at the participating school, we collected evaluation data to determine the strengths and limitations of the program. Each member of the university team prepared a reflection paper at the end of the academic year. The six graduate students were asked to assess the situation at the school (e.g., what did they observe, what seemed to work well, what could have been better), and to evaluate their learning from the seminar experience (benefits, frustrations). The elementary school principal and teachers prepared written responses to a set of open ended questions (benefits, limitations, students' responses to Tech Days, and any additional impact the sessions had on their classes). In addition, the librarian and course professor each prepared a reflection paper on their experiences. Five of the ten teachers failed to complete questionnaires. Data were collected from all other participants.

The university team conducted a qualitative analysis of the responses to questionnaires and reflective statements, looking for general patterns and themes across individuals. The responses of the graduate students and their professor were combined for analysis because,

within the context of the school activities, their roles and responsibilities were the same. Conversely, the teachers', librarian's, and principal's data were analyzed separately, due to the unique perspective gained by each group. As the instructional sessions were conducted in the library in cooperation with the librarian, she worked with and observed each of the classes during Tech time. The teachers observed their students' transfer of skills to the classroom, but seldom observed them during their Tech sessions. The principal was aware of the Tech sessions and their impact on the school, but did not participate in the day to day activities of the program.

It is important to note that participants responded to a very open-ended questionnaire. Thus items listed were those that were most salient in their minds. Although many good ideas emerged in the reflections of individual participants, only those ideas listed by several participants are mentioned in the discussion of the results.

Results

Several benefits and limitations to targeting students for technology training in a community of learners were noted by the university and school teams (see Figure 1). For the most part, the benefits noted were qualitatively different from the limitations noted.

Insert Figure 1 about here

Benefits

One of the most obvious benefits noted by the university team, the teachers, librarian, and the principal was the increasing motivation of the teachers to learn about and use technology in their classrooms. The librarian noted that "as the program progressed and student enthusiasm increased, staff members began to join in." One teacher stated, " It's made me want to learn more and use it more to teach and evaluate." The principal stated that the teachers' response was "very enthusiastic-- it has increased technology use many fold."

One of the graduate students provided the following example in her reflection:

> " For example, Mr. X (teachers name) inquired about how one might incorporate HyperStudio into the social studies curriculum. . . . The teachers were drawn to the computer as the students explored the software and often asked the student or university personnel for explanation or clarification of particular computing procedures. Teachers became curious about their students' expanding computing skills and lost their reluctance to ask questions and become a part of the learning environment."

The change in the attitudes and motivation of the elementary students was also noticed by the teachers, university team, librarian, and principal. One teacher whose students attended a

Tech session on Friday stated that "They looked forward to each Friday. Fridays when we weren't in school were days the kids wanted to make up."

Tech Days seemed to change more than the attitudes of teachers and students; the experience seemed to change the way technology was used for learning. These changes were noticed by the classroom teachers, librarian, and university team. One teacher commented that students, "transfer their knowledge to the classroom computer and are more independent learners in class." The university team noted that students "were better able to use available resources found on the computer. . . They were quick to learn the basics and were able to explore and experiment with available software. They began to rely less on teacher direction and more on self-exploration." A graduate student noted that "providing them with a 'theme' was sufficient enough to get them exploring. For example, we told the MCMs (technology 'expert' students) one week to look at the different button options on HyperStudio. It was not long before they were discovering how to include sound and video."

The librarian offered this example in her reflection:

> " When a 'special needs' student, having accessed a travel CD ROM, then called long distance to a state travel bureau and requested material for a project--doing all the speaking himself even though speech is difficult! . . . . It was a day of true success!!!"

But students were not the only school members who became more confident and self-directed as the year progressed. The university team members noticed that the librarian also became more independent in her use and teaching of technology. One member commented, "I am excited for (librarian), for in the short time that I've worked with her, I have seen her get more and more confident and involved in the technology." Another student provided the following example in her reflection: "The librarian was so excited that she just took over the teaching task and taught the kids by herself instead of her original role as an organizer."

Although the classroom teachers and the school principal noted that the elementary students became comfortable in using technologies and had learned technology skills upon which they could build, the teachers seemed to understand that their students had learned more than simply discrete technology skills. They noted that students had learned about learning in addition to learning about technology. One teacher commented that, "This instruction gave them a means of reporting and learning which wasn't there prior to the Tech Days." In addition, teachers reported using technology more often in their classrooms as a means of reporting and learning. One teacher provided the following example:

> "After Hypermedia was introduced to the class, I allowed students in small groups and also in pairs to create cards to present materials learned about plants and animals."

Two additional benefits frequently noticed addressed the interpersonal benefits of establishing such a learning community. The principle and university team felt that the collaborative working relationships among all members of the groups were especially valuable. University team members commented, "There is a tremendous benefit when the project team works together." " Members brought their individual expertise to the meetings which expanded the group's repertoire of knowledge." And the principal commented that the Tech program had "raised (the) comfort level with PDS (university/elementary school) collaboration."

In addition, both the librarian and university team noted the personal benefits of the graduate students' work with elementary students and teachers. One graduate student commented, "I have not had many opportunities to work with elementary school children. This was a great experience" and "(I learned) things related to implementation of projects in public school settings. Policies and psychology are very different from business." The librarian noted that her most memorable moments involved "watching the graduate students develop a relationship with the (school) children-- Sharing their expertise with the children, but also building a lasting rapport with them, one forged from mutual respect!"

Limitations

In contrast to the benefits, which focused primarily on increased motivation, changes in learning styles, and interpersonal benefits, most of the limitations focused on logistical issues.

A critical limitation was the restricted number of computers. With an average of twenty students in each class, the six to ten computers available during Tech time was considered problematic by the university team, teachers, librarian, and principal. Both the classroom teachers, who had to do without computers in their classes during Tech time ("Having to give up my Power Mac for 2 days wasn't convenient"), and the university team members working with the students during Tech time ("Students in groups of 2 or 3 are not able to complete assignment . . . might be solved by increasing the amount of available technology in classrooms so that students and teachers have greater access to hardware and software") noted the inconveniences.

The university team members and teachers felt that they had too little time with the elementary students. One university team member commented, "We always seem to run out of time. The sessions need to be at least one hour long." One teacher echoed this sentiment stating, "sometimes not enough practice time" for the students.

The classroom teachers and university team also felt the need for more personnel "so that all students have an equal opportunity to learn and to have their questions answered" (comment from university team member). One graduate student commented that we "really need at least one teacher or qualified helper to every 3-4 students to really help them." A teacher commented that "we are only limited by funding. . . as well as instructional personnel."

In some respects, the limitations point to the success of the program; both the school community and university community wanted more: more computers, more time, more people. However, one limitation identified by the university team was not logistical in nature. The university team would have liked more active involvement on the part of the classroom teachers. Granted, students took skills back to the classroom and teachers responded to their increased skills by integrating computer technologies into their classroom activities. However, the university team would have liked teachers to be more actively involved in the implementation efforts. One graduate student provided the following recommendation, "Include classroom teachers more. I don't know if I would say that they needed to be with us during the session, but perhaps, we could have had an hour interaction with them each month. During this session with all the teachers, new ideas could be generated/discussed to help transfer the technology skills into the classroom."

Discussion

The intent of this project was to create a community of learners in order to facilitate the implementation of computer technologies in the elementary school curriculum. The primary means used to achieve technology integration was student training. All students in grades one through five were trained in using computers as tools for accessing information and tools for expression. In addition, we offered one optional after-school inservice for teachers and an introductory computing class at a nearby school. After evaluating the strengths and limitations of the program, the next year's project (1996-1997) began with some new goals and visions.

Due to the success of Tech Days in creating a community of self-directed and confident learners, we encouraged the school staff to continue Tech Days in a self-sustaining manner. Currently the Tech Day program continues each week, thus providing each student with hands-on technology experience. Rather than relying on the university team to provide instruction, the librarian and teachers operate the weekly program. This is a logical extension of the increased confidence in using computer technologies gained by the librarian and teachers during the 1995-96 school year.

In response to the need expressed by the university team for extended interactions with the elementary students, we have initiated an after-school technology training program. A group of 24 students were selected to receive additional computer training. Twenty of these 24 students agreed to attend the "computer masters" after-school sessions for one hour of instruction each week. The program goal is to provide individualized computer training for a small group of students who will then serve as technology tutors/experts for their teachers and peers. Various skills including desktop management, word processing, HyperStudio design, scanning, and shooting XapShot pictures were targeted for this year.

Based on the need perceived by the university team for increased interactions with the teachers, we established a team of university and school personnel to work together to create a shared vision for the school's technology program. Members serve as co-chairs for various components of the program such as funding, research, and student/teacher computer training. Meetings are held once a month with additional communication through e-mail, phone calls, and school visits. This continual communication has helped strengthen the university/school relationship as we work toward achieving common goals.

In order to support the teachers' desire to learn more about incorporating computer technologies in the classroom and to build upon their motivation to implement computer technologies, we are providing in-service workshops for the teachers. The university/school team are working together to plan and present a total of three workshops. As a result, teachers receive technology training relevant to their specific instructional needs. Although training on different pieces of hardware and software is offered, each workshop also addresses integration issues through discussion, examples, and sample assignments.

While data are currently being collected through student and teacher interviews, inventories, and technology surveys, comments from the school staff continue to be positive. A common observation is that the amount of computer usage by students and staff has increased dramatically over the past two years. In addition, the enthusiasm towards technology continues to increase. Plans for the program's third year (1997-98) include continuation of the Tech Day program and the after-school computer club as self-sustaining programs. As the university/school planning team continues to meet and work toward their common vision of a technologically integrated learning community, research will be conducted in individual classrooms to investigate the interactions among this year's "computer masters," their teachers, and their peers.

Conclusions

In contrast to the traditional approach to computer training in which teachers are trained in the hope they will share their skills with their students, this study implemented and evaluated the effectiveness of a "bottom-up" approach, where students were trained in computing skills in order to distribute expertise across a community of learners. As the first year of the project progressed, we observed teachers becoming more frequent users of technology, expressing a greater desire to learn along with their students. Teachers became curious about their students' expanding computing skills and lost their reluctance to ask questions. In the end, teachers began to use their students' expertise to increase their own computer skills.

In addition, we have found that using students as technology leaders impacts the entire educational community. Student skills are transferred to the classroom, teachers become more

motivated to learn to use technology and to incorporate technology in classroom activities. The results suggest potential benefits for teachers, students, and schools. We believe this approach would be beneficial to others struggling to integrate technologies into elementary school curricula. As the librarian stated:

> "The (School) Tech program is a working example of the administration, the teachers, the media specialist and the community collaborating to create a program and atmosphere where each student can explore his or her own talents to the fullest."

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Figure 1

Most Frequently Mentioned Benefits and Limitations of Technology Program

	Classroom Teachers	School Principal	School Librarian	University Team
Benefits				
Teachers more motivated to learn and use technology	√	√	√	√
Teachers implement more in class	√	√	√	
Elementary students more motivated to learn and use technology	√	√	√	√
Elementary students more self-directed learners	√		√	√
Elementary students more comfortable with technology	√	√		
Elementary students learned new way of learning	√			
Graduate students gained experience working in public schools			√	√
Librarian more confident & self-directed teaching technology			√	
Learned value of collaboration		√		√
Limitations				
Too few computers	√	√	√	√
Sessions with elementary students too short	√	√		
More personnel needed	√			√
More teacher involvement needed			√	

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