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ABSTRACT

A junior high/middle school science improvement project established by the New Jersey Institute of Technology and Fairleigh Dickinson University is described in this report. Among project goals are: to improve teacher skills and qualifications in science teaching and offer access to instructional resources; to eliminate teacher isolation; and to develop inter-district collaboration. This collaboration among university and secondary school science teachers has resulted in a model for the professional development of science teachers and improvement of science curricula. The model includes a regional computerized resource-sharing network that actively involves teachers in exchanging and integrating successful approaches, materials and curricula into their teaching practices. Inter-district cooperation and participation in curriculum and resource development occurs because the geographical boundaries normally constraining such a process are eliminated. The network reduces isolation of teachers from their peers and provides opportunities to seek help from experienced colleagues and university faculty. It brings the outside world to the classroom and takes students into the world to discuss topics of interest with students in other locations, visit with scientists, and participate in inter-school activities. The use of computer conferencing has increased throughout the duration of the project. (Author/SM)

JUNIOR HIGH/MIDDLE SCHOOL
SCIENCE IMPROVEMENT PROJECT

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AASCU/ERIC Model Programs Inventory Project

The AASCU/ERIC Model Programs Inventory is a two-year project seeking to establish and test a model system for collecting and disseminating information on model programs at AASCU-member institutions--375 of the public four-year colleges and universities in the United States.

The four objectives of the project are:

- To increase the information on model programs available to all institutions through the ERIC system
- To encourage the use of the ERIC system by AASCU institutions
- To improve AASCU's ability to know about, and share information on, activities at member institutions, and
- To test a model for collaboration with ERIC that other national organizations might adopt.

The AASCU/ERIC Model Programs Inventory Project is funded with a grant from the Fund for the Improvement of Postsecondary Education to the American Association of State Colleges and Universities, in collaboration with the ERIC Clearinghouse on Higher Education at The George Washington University.

ABSTRACT

New Jersey Institute of Technology and Fairleigh Dickinson University have established a collaboration among university and secondary school teachers, in which a model has been developed for the professional development of science teachers and improvement of science curricula. The model includes a regional electronic resource-sharing network that actively involves teachers in exchanging and integrating successful approaches, materials and curricula into their teaching practices. Inter-district cooperation and participation in curriculum and resource development occurs because the geographical boundaries normally constraining such a process are eliminated. The network reduces isolation of teachers from their peers and provides opportunities to seek help from experienced colleagues and university faculty.

INTRODUCTION

Conventional modes of information exchange -- telephone, mail, meetings, journals, newsletter, etc. -- no longer meet educator's growing needs for timely communications and information exchange. This is critical for pre-college teachers, whose structured workday creates a sense of isolation from their peers. Few opportunities exist for them to meet on a regular basis to share instructional ideas and resources. Although many teachers have developed new methods and materials to improve classroom instruction, implementation is limited to the small number of students they teach. There are no resources at their schools for disseminating the results and evaluating their utility in other settings. The absence of an effective communications network causes the wheel to be invented many times over; the lack of systematic evaluation keeps concerned teachers from finding the best wheel available.

Computerized communication is an innovative approach for improving instruction. It can support educators with a wide variety of information services, which include support for professional development and curriculum improvement efforts. Telecommunications not only bring the outside world into the classroom, but also takes the students and classroom into the world to discuss topics of interest with students in other locations, "visit" with scientists or other professionals, and participate in inter-school activities. It can provide the opportunity for students to meet and work with their peers and experts at distant locations.

Through this medium, teachers and their students become involved in new and stimulating experiences, that are not limited by the constraints of time and class scheduling. The ability to send text long distances instantly allows interaction to become global in scale.

BACKGROUND

A review of past efforts to improve teaching practices indicates resistance to change is rarely overcome. Administrators and supervisors working within the schools may find it difficult to influence teacher behavior because of past performance or attitude problems. It has been reported that teachers rely upon their peers as the most trusted models for change. Teachers tend to view in-service education as ineffective, poorly planned and an administrative rather than teacher responsibility. Too frequently, in-service experiences exist in the form of late afternoon general lectures or hastily contrived programs with few planned linkages to teaching practice and infrequent follow-up to actual classroom functioning. Without the commitment and support of the building principal, there is little change in the classroom. The success or failure of efforts to change aspects of science teaching are closely related to the principal's commitment to support the intended changes.

Efforts to improve science instruction have tended to focus on curricular revisions based on federally funded projects. One study showed that although typical NSF-funded curriculum projects were directed by prestigious scientists, classroom teachers were not involved in decisions about instructional tasks. Moreover, the implementation of curricula developed outside of the schools was attempted without teacher training.

An additional concern is reflected in the call of state education officials to increase collaboration between pre-college educators and university faculty.

We believe that substantive and lasting changes in teacher behavior can occur only if teachers identify and want these changes. Teachers can be effective sources for instructional improvement because peers respect the judgments of those who have previously implemented a skill or set of ideas in the classroom. Unfortunately, opportunities to continuously share instructional resources among teachers are limited. A widely distributed report of the U.S. Department of Education suggests the negative outcomes of professional isolations: *"In some studies, as many as 45 percent of the teachers report no contact with each other during the workday; another 32 percent say they have infrequent contact ... these teachers fail to share experiences and ideas or to get support from their colleagues. Isolation may undermine effective instruction."* Because of the time constraints of their daily teaching schedules, teachers need help finding instructional resources, and are usually limited to those available in their department or school libraries.

PROJECT DESCRIPTION

Fairleigh Dickinson University (FDU) and New Jersey Institute of Technology (NJIT) have developed a new model of in-service education for science teachers designed to increase the opportunities for teacher interaction and the availability of instructional resources. This model emphasizes teacher control over their own needs. It includes both traditional in-service procedures and use of advances in communication technologies.

Participants in the project come from nine county areas of Northern and Central New Jersey and include teachers from urban, suburban and rural school districts. Backgrounds vary from teachers with good science background to science teachers with weak science backgrounds and include self-contained classroom teachers, science only subject teachers, basic skills teachers and special education teachers.

The goals of the project are to:

1. *Improve teacher skills and qualifications in science teaching and improve teacher access to instructional resources;*
2. *Eliminate teacher isolation by the opportunity to interact conveniently with their peers; and*
3. *Develop inter-district collaboration in the improvement of science instruction.*

The three components of the model are teacher-centered workshops, focused visits by university faculty to the participants' schools, and computer-mediated communications. The communications system is known as the Electronic Information Exchange System, or EIES. Each component of this triad is described below.

Workshops

Six in-service workshops are typically held on Saturdays that are distributed across the academic year. These workshops provide teachers with hands-on experiences and face-to-face meetings not available to them through computer-based telecommunications. Through resource sharing and informative presentations to their peers, the teachers develop a common background of professional development experiences intended to encourage the computer conferencing that takes place between these otherwise traditional in-service activities.

A typical workshop starts with teacher-tested laboratory activities and demonstrations related to a theme they have selected for the day. During the afternoons, visiting experts may present technical information related to phenomena observed during the morning activities, while new members become acquainted with EIES. Each workshop session closes with group discussions about student centered projects being conducted on EIES and the selection of the next workshop theme.

School Visits

Visits to school sites by university faculty are conducted to gather support for the project from building principals and to help participants adapt the training in computer-based telecommunications to the equipment they use at their schools. Classrooms are visited and department chairs consulted so that the project will be valued and supported. Visits, however, do not link the participants between workshops. That is the function of EIES. As described below, EIES is used to keep teacher participants in frequent contact with each other between workshops.

Computer Conferencing on EIES

EIES (the Electronic Information Exchange System at the New Jersey Institute of Technology) is a computerized conferencing system that includes electronic mail, conferences (in which a permanent and modifiable transcript of the proceedings is maintained), notebooks (designed for joint composition of documents), and tailored communication structures to meet the special needs of users.

EIES allows geographically dispersed participants to be linked through microcomputers and local telephone calls. Teachers participate at the site, time, and pace of their choosing. Time, cost and distance are minimized as barriers to interaction.

Educators communicate with their peers and experts and translate this information exchange into effective classroom teaching. Online dissemination is a process of linking teachers with resources and includes follow up. Mechanisms to support group processes, including decision aids, survey capabilities, voting and databases tailored to the needs of the group allow the participants to develop and assess criteria for evaluation.

EIES supports several kinds of communications between individuals and groups. Our project participants communicated from their schools, homes or any other location where they have a microcomputer, modem, and access to telephone lines. The system allows users to communicate in any of the following ways:

- Messages can be sent from a participant to one or more intended recipients, or to a special interest group, and may be open or blind copied. There is the option of using a regular signature, pen name, or anonymity. Those to whom messages can be sent are not restricted.

Each message is routed to the receiver and stored in memory until he or she signs onto the system. The participant sending a message is notified when a message has been received. Messages are stored for approximately three months. This aspect of EIES is similar to electronic mail.

- Participants sharing a common interest or task can communicate as if they were at a conference. Participation is usually "asynchronous" but may at times be conducted in "real time." These computer conferences benefit from the storage and search capabilities of the system. Individuals participate at the time and location of their choosing. All contributions are retained in a continuously evolving "proceedings" that is permanently stored. This feature of EIES is frequently used by the teachers in this project. They submit laboratory procedures and data sheets, contribute new demonstrations and laboratory activities related to a recent workshop or share questions and information through this utility. Participants may choose to compose their contributions on the EIES text editor or prepare their material ahead of time on a conventional microcomputer word processor. Word processed documents can be "uploaded" right into the conference proceedings without a great deal of computer skill. The search and retrieval capacity of EIES also allows participants to retrieve the contributions of their colleagues as needed by utilizing the equivalent of an ERIC descriptor.

- Electronic notebooks for document preparation are available for project participants to compose documents (data sheets, survey forms for data collection, etc.) in small groups. In fact, this document was prepared by the authors at various times and locations using the notebook facility.

A major feature of EIES is the ability to electronically transfer text files. Thus, laboratory procedures or survey forms prepared in a notebook can be moved or copied easily into a conference.

This model is unique because it allows teachers to join at any time, regardless of location, and access resource materials, receive support from college-level educators, and a access collection of teacher-validated activities for enhancing science curriculum and teaching. As a result, major obstacles can be overcome which have impeded the restructuring of science content and teaching. The model addresses the isolation of school teachers from resources outside their immediate teaching environment, as well as the major identified root of the failure to implement new curricula - the lack of continuing support and assistance for teachers during the implementation process.

Traditional curriculum development has been a school-based effort. Where states do not dictate content, proficiencies and curriculum vary widely. The implementation of a new curriculum is a local isolated event under these circumstances. This project has initiated inter-district cooperation and participation in curriculum, resource and activity development in a way that is not possible by traditional means. There are no geographical limitations to this process.

Formative evaluation of these teaching improvement efforts is facilitated by EIES. The system allows ongoing data collection about the level of activity of each participant and school. The need for occasional supportive school site visits is based on low online activity levels. Schools and teachers with exceptional activity are also identified, so that site visits are also made to identify conditions conducive to high-level participation.

An Online Curriculum Materials Retrieval System

The development of an electronic curriculum resource retrieval system is now being undertaken on EIES. Educators seeking classroom materials related to a topic they are teaching can retrieve these resources at their school computer for classroom use. Database retrieval systems are not new. What has been absent is a database that can provide both information and curriculum materials for elementary and secondary school teachers in a way that is simple to use and sensitive to the highly structured nature of the school day. Only material that has been classroom tested and evaluated by teachers in terms of utility and appropriateness for a given grade level and subject is retained in the system. One long-term goal of this service is to replace the textbook as the core of the science curriculum.

Direct Student Involvement

Part of the NJIT-FDU effort has involved inter-school student projects. For example, two eighth graders at a middle school in Northern Jersey and an eighth grader at a middle school in Central Jersey worked cooperatively on activities from a curriculum packet on Astronomy (provided by the American Association for the Advancement of Sciences). Using homemade astrolabes, shortwave radios and clocks, they determined the longitude and latitude of their respective schools.

More recently, teachers and students have become involved in acid deposition measurements. They are collecting rain and snow samples and reporting the pH values as pooled data. Results are compared for different school locations. All reported data and collected results are being stored in a conference on EIES. Other teachers and students are studying the quality of water in local estuaries. Thus, an online experience is being provided in the classroom in which there is a sharing of scientific data by students in geographically dispersed locations. Electronic communications are used for planning, measurement reporting, decision-making, exchanging data, and pooling data collected.

The newest efforts are linking New Jersey schools with schools in the United Kingdom in order to demonstrate to the students that the environment is not a local concern, but that it is a global problem. Collaborative projects include the study of acid rain, water quality in local estuaries and solid waste management.

RESULTS

Participating teachers maintain communications over EIES as a follow-up to workshop activities and as a support during their efforts to implement what they learn at workshops. A review of the EIES conference transcript for this project revealed that teachers:

- Ask questions related to theory and principles presented at workshops;
- Permit students to ask questions of the university faculty during and after class time with teacher supervision;
- Share teacher prepared support materials including worksheets and data sheets matched to lab activities at workshops:
- Contribute teacher developed activities related to workshop themes for later retrieval by their colleagues; and
- Evaluate workshops, suggest themes and activities for upcoming workshops, and recommend changes to the entire project.

The use of computer conferencing has increased throughout the duration of the project. Although initial activity in many telecommunication projects is often followed by declining enthusiasm, this has not been the case of these EIES users. Some credit for this observation is due to the development of the collaborative school based investigations that call for wide are data collection. EIES is used by teachers to pool data collected for projects such as:

- The sharing of meteorological data related to storms crossing over New Jersey: amounts of precipitation, wind directions, duration of storms, and pH of precipitation;

- The use of short wave radios and chronometers to determine the longitude and latitude of participants' schools and sharing of the findings over the network;
- The development by teachers of a resource retrieval database. In the future, participating teachers will be able to download investigative activities from the database for local duplication and distribution in their classrooms.

Various data collection methods have been used to track participation of the teachers in the computer conferencing system.

Figure 1 presents the results of a Conference Traffic Analysis, showing how the conference activity changes over time. This activity is presented in terms of the number of new comments each month and the number of authors of those new comments. From November 1984 to November 1986, membership in the conference gradually increased from 29 to 52. The number of comments also increased during this period. The graph illustrates that participation has been uneven, with only a minority authoring comments. High point are seen in November 1985 and November 1986, where almost 60 comments were contributed each of those months, but only 32% of the members of the conference. Some members are in the passive or "read only" mode, while others are both reading and actively contributing. The number of active contributors ideally should increase over time, as people become comfortable with the medium and incorporate it into their routine communication patterns. This is reflected in the increase in conference activity during the second year, beginning September 1985. Balancing this, however, is the periodic introduction of new members to the group, who in turn must become comfortable communicating via this technology.

Figure 2 refers to the "Percentage Read" in the conference, and indicates the extent to which the members are up to date over time. The solid line refers to those who read at least 80% of the comments, whereas the dotted line represents those who read less than 20%. Note that these lines are not mirror images of each other, since only the polar extreme groups are graphed. Of the 29 members of the conference in November 1984, about 30% had read at least 80% of the ten comments that then existed, whereas 65% had read fewer than 20%. Again, the data shows marked improvement over time. By November 1986, those relatively up to date had doubled over the two year period, and those who had read less than 20% decreased substantially to 4% of the members.

Cumulative time usage for each participant is collected monthly, so that the amount of use and changes in that amount can be systematically tracked. These data are used as monthly feedback to the project directors, to pinpoint teachers in need of special help. Overall group statistics show that, in addition to conference activity, teachers are also exchanging private messages. There is also considerable activity in other EIES conferences. The teachers are part of the "electronic migration" often observed among EIES users -- although they join the system as members of a specific task-oriented group, they find other individuals, groups, and activities that match their needs and interests. There is also notebook activity, suggesting that some coauthoring of papers or documents is taking place. This substantial use of EIES strongly suggests that the project has begun to eliminate the isolation of teachers from their peers by overcoming the limitations of the physical boundaries of the classroom.

An initial analysis of conference comments referring to specific topics reveals that teachers continually refer back to comments entered into the system in previous years. This suggests that previous topics are accessed as needed for use in the classroom. The computer conference itself, then, acts as a dynamic resource retrieval system.

CONCLUSION

Without question, computerized networks for teachers significantly reduce their isolation from peers and provide opportunities for interaction to share resources and strategies, seek help from experienced colleagues, and work cooperatively to develop new curricula and instructional methods. In-service teacher education can be facilitated through computerized conferencing. Aspects of teaching that can be supported by computer conferencing include:

- *Disseminating information about new curriculum materials;*
- *Interacting directly with curriculum developers;*
- *Collecting evaluation data from teachers who have tested materials in their classrooms;*
- *Planning training sessions with teachers that are tailored to their needs;*
- *Sustaining post-workshop enthusiasm through continued interactions among workshop participants;*
- *Connecting teachers to resource people throughout the academic year as teachers work to implement and adapt materials to their local curriculum;*
- *Formative evaluation of new materials, instructional strategies and implementation plans.*

Innovation aspects of the project include:

- *Participant ownership and direction of training workshops. Teachers can diagnose their own needs and prescribe resources and services for themselves; University faculty can assist and coordinate this process, providing content and pedagogical expertise.*
- *Enhancement of traditional school-college collaborations with computerized conferencing, Inter-district cooperation and participation in curriculum development now exists in a way that is no longer restricted by geographical limitations of school district or even state boundaries. Science teachers are thus involved in a dynamic process of curriculum development, implementation and evaluation that weds the power and capability of the computer with traditional methods.*
- *Inter-school collaborative projects. Currently, students are involved in inter-school projects that, otherwise, would not have been possible.*

Computerized communications enhance these activities, save on time, travel and costs that would otherwise be incurred if these functions were to take place at face-to-face meetings. Traditional methods of group interaction and materials dissemination no longer suffice.

A multiplier effect has begun to occur as the teachers involved have become resource people for their colleagues. The Computerized Conferencing System acts as a project management tool, with features for project design and planning, implementation of successful curricula and instructional practices with interactions among workshop participants, disseminators, and resource people. This communications network also meets a major concern of teachers: the inability to communicate regularly with peers and their resulting isolation. Although many teachers have introduced new methods and materials into their classrooms, the impacts have been limited. No effective, institutionalized means exist to disseminate the results or to evaluate their utility in other settings. This project provides a model for an effective communications network and a systematic evaluation mechanism, so that the "wheel" need not be continually reinvented.

Post-secondary institutions have the technology and experience to adopt the model to their facilities and the needs of teachers and schools in their regions. Pre-college teachers need to continuously update their subject matter expertise. Cooperation among participants (pre-college and post-secondary educators) must be encouraged and nurtured at all levels if higher education is to play a large role in the teaching reform movement of the 1980s.

Most institutions have the necessary computer facilities to use available software for establishing a computerized conferencing system. Thus, face-to-face meetings need not be the limiting factor in the establishment of University-school collaborations. Geographical and time considerations are no longer factors.

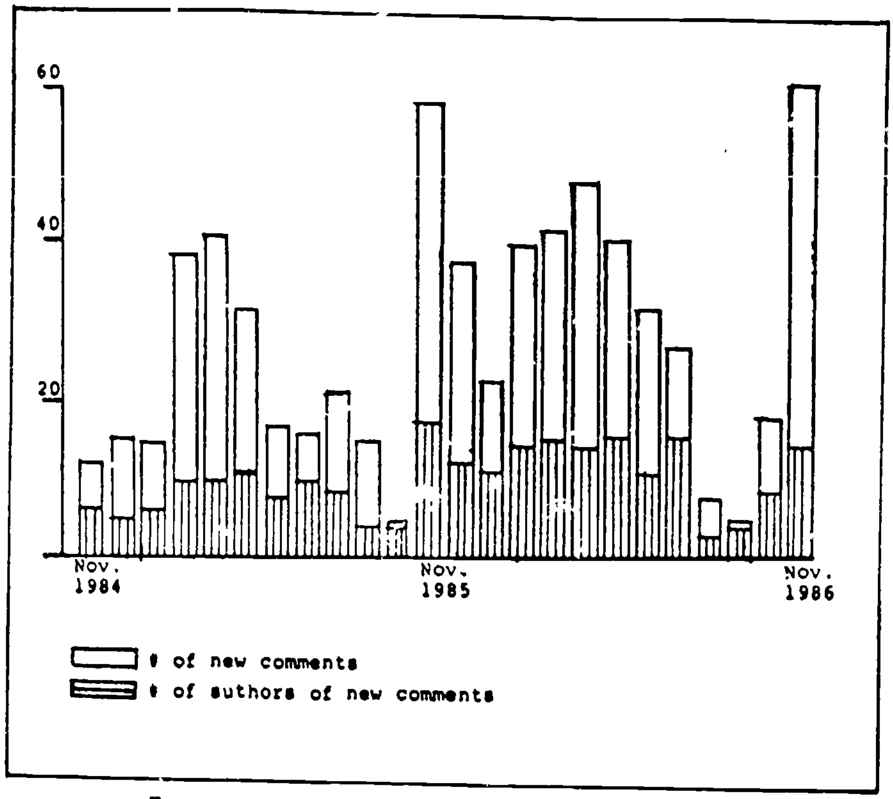

Figure 1. Conference traffic analysis: contributions over time.

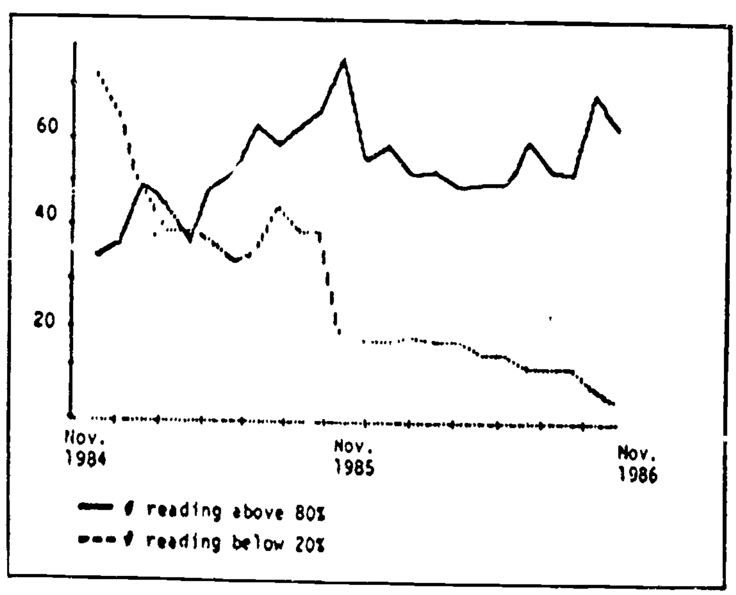

Figure 2. Conference participation over time.