Technology-Supported Cooperative Learning in Secondary Education

Dr. Sheila Brandt, University of Arizona, Tucson, Arizona, USA
Mary Lonsdale, Palo Verde High School, Tucson, Arizona, USA

Abstract

After watching the results from electronic meeting systems (EMS) use in the business arena, educators are beginning to look at EMS as a tool for group learning. Many of the initial educational uses of EMS have been focused at the university level, and only a few school systems have put the technology to use in the public schools. The University of Arizona's GroupSystems was installed at a local Tucson high school for the academic year 1994-1995. A junior level English class at the school put it to a variety of tasks. These included prewriting brainstorming, answering lecture questions, writing letters and dialogues, and producing a research paper. Preliminary results indicate that the students in this particular class surpassed their peers in both cooperative (process) skills and writing (product) skills.

The Problem

Anyone around the world who has picked up a newspaper or magazine or has turned on the television knows that American public education is in deep trouble. This recognition was stated in a startling report called "A Nation at Risk: The Imperative for Educational Reform" by the National Commission on Excellence in Education in 1983. Its findings included:

- International comparisons of student achievement, completed a decade ago, reveal that on 19 academic tests American students were never first or second and, in comparison with other industrialized nations, were last seven times.
- About 13 percent of all 17-year-olds in the United States can be considered functionally illiterate. Functional illiteracy among minority youth may run as high as 40 percent.
- Average achievement of high school students on most standardized tests is now lower than when Sputnik was launched.
- The College Board's Scholastic Aptitude Tests (SAT) demonstrate a virtually unbroken decline from 1963 to 1980. Average verbal scores fell over 50 points and average mathematics scores dropped nearly 40 points.
- Many 17-year-olds do not possess the "higher order" intellectual skills we should expect of them. Nearly 40 percent cannot draw inferences from written material; only one-fifth can write a persuasive essay; and only one-third can solve a mathematical problem requiring several steps.
- Business and military leaders complain that they are required to spend millions of dollars on costly remedial education and training programs in such basic skills as reading, writing, spelling, and computation.

These indicators represent disturbing academic findings, but to the average public school student, the decline of the educational system is very personal. Students are frightened by the reality of guns, violence and gang activities in the schools. They feel threatened by the drugs all around them, both in and out of school. They see classmates drop out of school because of jobs, boredom, stress and pregnancy.

Many attempts are being made to "fix" education. Politicians and community groups meet endlessly to discuss possible solutions. Partnerships are forged between the business community and the schools. Many computers and other technologies are installed for student use. Educators debate "whole language" versus "hooked on phonics". Curriculum is re-examined to determine relevancy. Teen parenting classes are offered, as well as classes in leadership and conflict resolution. New standardized tests are developed, delivered, published and discarded. Security is enhanced by fencing the campuses and installing metal detectors.

In spite of all the measures which have been instituted, the findings of a second report entitled "Ten Years After a Nation at Risk" were not promising. The authors of this second report stated, "Participants in this study offer no congratulations on the progress of educational reform since the publication of 'A Nation at Risk'" (Lund and Wild, 1993; p. 2). They are moderate in their praise of business involvement. The sense is that even though American education reform is still on track and new players are committed to this task, our Nation still remains at risk.

Cooperative Learning

It is apparent that some method of education must be found which will engage America's youth, will raise knowledge and test scores, and which will help focus toward life-long learning. Among other possibilities, cooperative learning stands in high regard by educators who have used it.
Cooperative learning is the instructional use of small groups of students who work together to maximize their own and each other's learning. Of course, learning groups are a common method of classroom organization. No doubt every teacher has put students together and assigned a project or task to be done by the group. Although many teachers use traditional learning groups, cooperative learning is different in five essential elements:

- **Positive Interdependence** -- Tasks are structured by establishing mutual goals, joint rewards, shared resources, and assigned roles. Positive interdependence is the heart of cooperative learning.
- **Face-to-Face Interaction** -- Students promote each other's learning by helping, sharing, and encouraging efforts to learn. Students explain, discuss, and teach what they know to classmates. Teachers structure the groups so that students sit knee-to-knee and talk through each aspect of the assignment.
- **Individual Accountability** -- Each student's performance is frequently assessed, and the results are given to the group and the individual. Teachers may structure individual accountability by giving an individual test to each student or randomly selecting one group member to give the answer.
- **Group Skills** -- Teachers teach social skills as purposefully and precisely as academic skills. Cooperative skills include leadership, decision-making, trust-building, communication, and conflict-management skills.
- **Group Processing** -- Group members discuss among themselves how well they are achieving their goals and maintaining effective working relationships. Teachers also monitor the groups, giving feedback to individual members on how well the groups are working together. (Johnson, Johnson, and Holubec, 1993).

Cooperative learning has great potential for three reasons. First, cooperative learning directly teaches the skills sought by employers:

a) the ability to apply new information quickly
b) listening and oral communication skills
c) competence in reading, writing and computation
d) adaptability: creative thinking and problem solving
e) personal management: self-esteem, goal setting/motivation, and personal/career development
f) group effectiveness: interpersonal skills, negotiation and teamwork
g) organizational effectiveness and leadership (American Society for Training and Development and the U.S. Department of Labor, 1988).

Second, as any teacher knows, the best way to learn new material is to teach it. The learner's retention rate of any material is comparatively high when it is taught to other people. The common "stand and deliver" lecture method of teaching arose before widespread printing and books were available. It was simply more efficient for a teacher who had the information to relate it to students verbally. The lecture method has remained throughout academia, especially in large classes. This anachronistic method is still very popular, despite studies which show that students "tune out" of lectures within fifteen minutes of the beginning of class (Johnson, Johnson, and Smith, 1991).

Furthermore, cooperative learning has been shown to raise achievement and retention rates, to produce higher-level reasoning, deeper-level understanding, and critical thinking (Johnson, Johnson, and Smith, 1991).

Third, most people lose their jobs because of a lack of good group and communication skills. Research has shown that when a company must lay off employees, 10% of the required layoffs occur because of a lack of technical or substance knowledge, and 90% because of a lack of interpersonal skills (Johnson and Johnson, 1995).

As might be expected, the role of the teacher changes during a lesson using cooperative learning. Instead of being "the sage on the stage", the teacher becomes the "guide on the side". In this facilitative role, the teacher guides, encourages and provides feedback to student teams in their pursuit of knowledge. The class becomes less teacher-directed and more student-directed.

Studies of cooperative learning have shown frequent positive results. Students practice more elaboration, more rehearsal, more planning, internalization of peer-provided metacognitions, more summarizing, and more comparison of alternative perspectives (Salomon, 1989). In addition to enhancing student academic achievement, cooperative learning has shown positive effects on student self-esteem, intergroup relations, main streaming, attitudes toward school, and ability to work cooperatively (Slavin, 1991). Finally, research shows that students plan more extensively and write more carefully when they know their work will be viewed by their peers rather than just the instructor (Bagley and Hunter, 1992).

**EMS for the Learning Environment**

Electronic meeting systems (EMS) offer promising support for a more active, cooperative, problem-solving learning environment. EMS technology, which has been used extensively in the business arena, has been shown to substantially improve the productivity of face-to-face work groups. Problem-solving teams in the field have reduced their labor costs by an average of 50%, and have shortened the elapse time for their projects an average of 90% (Dennis et al., 1988; Nunamaker et al., 1991).
An electronic meeting system improves the productivity of a problem-solving team by changing the way team members communicate, think, and access information. An EMS is typically based on a network of personal computers, usually one for each participant. EMS facilities for face-to-face groups usually have one or more large public display screens. Systems to support geographically distributed participants often have software that substitutes for the public screen (Nunamaker et al., 1991). People contribute to an EMS session by typing their ideas into a personal workstation. The system immediately makes all contributions available to the rest of the group.

As the number of people attending a meeting increases, people spend more and more time waiting for a turn to speak. This phenomenon is called airtime fragmentation. With little or no hope of getting the floor, some people withdraw, letting a few personalities dominate the discussion while good ideas go unspoken (Diehl and Stroebe, 1987). In an electronic meeting the opportunity to express an idea is never lost; everyone can "talk at once" by typing into their computers. The system makes all contributions available to the other participants almost immediately. This means that people don't lose track of their own ideas while listening to someone else, nor do they lose track of what others are saying while trying to remember what they want to say themselves, because all contributions become part of the permanent electronic transcript. Strong (or loud) personalities can no longer dominate a meeting or sidetrack it onto unproductive tangents. All participants have an equal opportunity to contribute. Because the input can be anonymous, ideas are considered on their own merits, rather than on their sources. Evaluation apprehension is reduced, and people can float unconventional or unpopular ideas without risk of losing face (Nunamaker et al., 1991; Zigurs et al., 1988).

An EMS is typically a collection of different software tools, each of which supports and structures group activity in some unique way. The EMS environment is designed to enhance the entire group problem-solving process from problem definition, to problem analysis, solution generation, alternative analysis, through consensus building. Typical EMS tools include electronic brainstorming, idea organizer, electronic voting, group outlining, group writing, shared drawing and diagramming, and structured alternative evaluation, to name but a few.

The same properties that make EMS useful in the business setting show promise for making EMS a useful environment for learning.

### EMS Support for Cooperative Learning

With cooperative learning methods, students are responsible for one another's learning as well as their own. Students actively engage in tasks geared toward team goals. Student teams actively search for information relevant to the task at hand. Once found, the students examine, discuss, and interpret that information in their process of knowledge generation. This environment is learner-centered and learner-controlled.

The traditional, lecture-based classroom setting typically does not allow many opportunities for student helping behaviors. In this setting, cooperative learning is constrained by available communication channels and limited time.

An EMS permits cooperative learning on a large scale. In an EMS environment, simultaneous, parallel processing is the norm, and thus, cooperative learning initiatives are not only supported but should be enhanced. All group members usually have access to a workstation and thus, each has an equal opportunity to contribute his/her ideas to the group discussion. Research has consistently shown increased participation for EMS-supported groups over their manual counterparts (George et al., 1990; Nunamaker et al., 1987; Vogel et al., 1988).

Further, studies which incorporated anonymity typically resulted in increased as well as more evenly distributed participation in EMS-supported, anonymous groups (Gallupe, 1986; George et al., 1990; Vogel et al., 1988). To extend this to the classroom suggests that all students can contribute simultaneously and anonymously, and students can respond to one another's work, arguing or defending their answers in simultaneous conversation. Thus, in the EMS classroom, students have many opportunities for giving and receiving useful helping behaviors.

Further, in the EMS classroom, while the students work at the same time, they can also work at their own intellectual speed. Thus, the EMS classroom is ripe with potential for active and cooperative learning to take place.

### EMS Support for Problem Solving

The ultimate goal of education is not to give learners lists of facts to memorize, but rather to teach them to think, to give them the building blocks necessary to solve problems. In the traditional classroom, instructors often pose simulated problems to students rather than asking students to solve problems in which they have a vested interest. Simulated problems are usually small-scale and have known answers, making them manageable in the classroom.
The EMS environment is designed to enhance the entire problem-solving process. With EMS, the instructor is not restricted to posing simulated problems. The students can work on problems in which they have an interest, which may motivate them to apply the cognitive effort required for learning. Because EMS technology makes group problem solving so efficient, the students can tackle more and bigger problems than would otherwise be possible. In one study of an EMS classroom, students collaborating with EMS technology support were found to have higher perceived levels of skill development, higher perceived learning, and higher perceived interest in the subject matter than their counterparts who collaborated without EMS technology support (Alavi, 1994).

Research Methods

With the expectation that EMS technology can provide a more effective, active, cooperative classroom learning environment, a field study of computer-supported collaborative learning was conducted. This field study included a quasi-experimental portion and a case study portion.

The Quasi-Experimental Portion of the Study

The research question driving this portion of the study was: Does EMS use in the classroom affect learning? The following hypothesis was developed in order to statistically test this research question.

H1: Classes using EMS will develop stronger writing skills than those classes who do not use EMS.

Class Selection

All of the ten junior English classes at one local high school were the volunteer subjects for this portion of the study. Each class had anywhere from nineteen to forty students. Two of these ten English classes were advanced placement classes. Most of the students in this school are from blue-collar backgrounds. 50% of incoming freshmen do not graduate from this high school due to attrition, not relocation. Of the graduating seniors, approximately 50% plan to attend college and only 40% of them will make it beyond their first year of college. As compared to other schools in its district, this school ranks in the bottom twenty-fifth percentile in terms of academic achievement.

Given the exploratory nature of this study and the limited availability of computers and computer lab time, only one class was given the experimental treatment while the other nine classes served as control groups.

Independent and Dependent Variables

The experimental treatment consisted of classroom use of an EMS to support group writing and problem-solving activities over the course of the school year. The software used in this study was GroupSystems, an EMS developed at the University of Arizona. On average, the experimental group spent approximately two to three days per week in the GroupSystems classroom.

Each student in each class was given a pre-treatment writing assignment and survey and a post-treatment writing assignment and survey to assess writing skill development and perceived writing product and process skill development. Quantitative difference scores (post-pre) for the writing assignment and the survey were tabulated and the class means were analyzed using an Analysis of Variance.

The Case Portion of the Study

In addition, the treatment group served as "the case" in this study and was consistently observed throughout the school year. The research question driving this portion of the study was: How is EMS used in the classroom over time? To determine patterns of classroom activities and interactions, field notes and formal interview transcripts were coded using a coding scheme developed specifically for this study.

The Subjects

One of the ten high school, junior-level English classes volunteered to participate in this case study. The instructor has been teaching for over twenty years and has taught at both the high school and the college level. This class was chosen for this study because the researcher had access to this class, the computer lab was available for this class period throughout the school year, and the teacher was willing to incorporate the use of the EMS software into her curriculum.

At the start of the 1994-1995 school year, thirty-eight students were in this class. 53% of the students were female and 47% were male. 18% of the students were Black, 21% were Hispanic, and the remaining 61% were White. The researcher observed the class as a whole, as individual students, and the interactions among students and with the teacher.

Throughout the 1994-1995 school year, the researcher spent approximately three or four days per week with this class and had become a fixture in the classroom. Approximately one-third to one-half of the class time was spent in the GroupSystems classroom. The remainder of class time was spent in the traditional classroom.
The Setting -- The GroupSystems Classroom

The GroupSystems classroom had a network of twenty IBM-compatible personal computers. Each personal computer was located at the corner of an L-shaped drafting table facing the interior of the L. Four sets of four tables were arranged in a cross fashion. The remaining four tables were paired due to limitations of physical room size.

One workstation near the front of the classroom was designated the facilitator station. At each of the remaining nineteen stations, students were paired for classroom activities. Throughout the school year, the teacher randomly assigned students to work groups and computer stations. Also, she periodically rotated the group membership.

Observations

During the 1994-1995 school year, the researcher observed the class on an ongoing basis in both the traditional and the GroupSystems classroom. When in the traditional classroom, the researcher attempted to be an unobtrusive observer. She used a timed narrative record to capture classroom activities and interactions. In the GroupSystems classroom, because the researcher ran the EMS software and facilitated the use of the technology, a narrative record of the class session was recorded immediately after each class period. All field notes were typed using a common format to facilitate coding and analysis.

Learning Perspective Interviews

In addition to direct observation, the researcher conducted informal and formal interviews with the students and the teacher. In the formal interviewing process, the researcher posed questions that revolved around the theme of learning and the interviewee's beliefs about learning. The questions were open-ended and were not preformulated. The formal interviews were audiotaped and transcribed by the researcher.

The formal interview with the teacher lasted approximately ninety minutes. In addition, the researcher formally interviewed one student for approximately forty-five minutes. This student was specifically chosen to be interviewed because she had been dubbed a "reluctant" learner by the school administration. She was a senior with sophomore credits who had returned to school fall term after dropping out during the previous school year.

Student Surveys

Once every three or four weeks throughout the 1994-1995 school year, the teacher administered a student survey to each member of the class. The survey asked each student to comment on the most recent (since the last survey) classroom activities. The questions were open-ended. The students were asked to give positive comments as well as constructive criticism about the latest classroom activities. The teacher and the researcher reviewed these surveys and looked for themes that supported/refuted their findings to date.

GroupSystems Classroom Activities

The following is a sample of activities undertaken in the GroupSystems classroom during the year.

1. Students brainstormed literary themes which they cared about and found significant in their lives. They also brainstormed responses to literature which they were studying. For example, they were asked to answer the question, "The Scarlet Letter deals with the themes of guilt and retribution. Does guilt affect your own lifestyle, and if so, in what various ways?" Or, "Do you know of incidences where people have suffered greatly or actually died from guilt?"

2. Student teams wrote numerous essays over the course of the school year. Typically these essays were exchanged anonymously for the purposes of suggesting, correcting, and editing.

3. The whole class wrote a "novelette" as a single group. This involved several steps, and was doable only with the aid of the EMS technology.

   First, students used the Electronic Brainstorming tool (EBS) to determine various characters to include in their story. Then the Vote Tool was used to select the top three to use as main characters. Then they followed the same process to decide on two main settings for their story. Next, using the Group Outliner tool, they created twenty or so chapter headings, and each team of two chose one chapter to write. Then the teams began to write their novel using the Group Writer tool, a tool that allows group members to write, edit, and review a document concurrently.

   Each team was responsible for checking the preceding and succeeding chapter to ensure the story remained coherent. The students held many verbal discussions about ideas from one chapter which could be continued in the next.
Finally, the finished story was printed out, and copies were made for each class member. The evaluation process consisted of individual assessment of length, accuracy of mechanics, creativity, consistency with neighboring chapters, and appropriate language. This was a “favorite” assignment of many of the students!

4. The largest cooperative writing project which was done on GroupSystems during the year was a research paper about careers of interest to the students in the room. This research effort involved many steps.
   a) Students used the EBS tool to brainstorm various careers open to today’s graduates. The teacher discarded the inappropriate ones such as drug dealer or prostitute.
   b) Using the Group Outliner Tool, students determined various issues which would be included in the final paper, deciding form and organization.
   c) Students designed an interview form to use with professionals in their career fields. These interview forms appeared in their final page of references.
   d) Based on student preference, the teacher created career teams of two to four people. For example, if one person wanted to be a court reporter, one a lawyer, and one a law enforcement officer, they were assigned the category “Careers in the Law.”
   e) The actual research was divided among the members of each team. The teacher adapted the student-generated outline of the final paper into four nearly equal sections: background of the career, educational requirements, benefits in the career, and future of the field.
   f) Each team determined which member would research which areas. They worked in the library and in the standard writing lab to research their chosen careers. They each did their own personal interview of a professional working in the field. Their assignment was to research only their section of the outline, but to share their information with the other people on their team.
   g) After completing the research and sharing the information with other team members, the actual paper was constructed in the GroupSystems classroom. Each team used the Group Writer tool to compose its research paper. Everyone on the team was told to edit the work of their team members. Any mechanical errors would be held against the whole team.
   h) The students spent seven hours in the GroupSystems classroom over the next week and a half. The results were very interesting. The papers were coherent and were written as if by one person. Each team member adapted his or her own personal style of writing to that of their teammates, giving unity of style to the paper. There was a great deal of face-to-face discussion among the members of the teams, deciding what to put where and which word to choose. All this verbal exchange was excellent, as it was on the topic, and was productive to the learning process.

Research Findings

Findings of this study provide strong evidence that EMS technology had a positive effect in the classroom.

Quasi-Experimental Study Findings

As mentioned previously, a quantitative score difference on the pre- and post-writing assignments was used to assess writing skill level difference. Because some students were not present for both the pre and post tests, a t-test by class was conducted to determine if the mean of the pretest scores of all students taking the pretest was statistically significantly different from the mean of the pretest scores of the students taking both the pretest and the posttest. Also, a similar t-test by class was conducted to determine if the mean of the posttest scores of all students taking the posttest was statistically significantly different from the mean of the posttest scores of the students taking both the pretest and the posttest. The following summarizes the results of these t-tests:

1. For each class, there was no statistically significant difference between the mean of the pretest scores of the group taking the pretest and the mean of the pretest scores of the group taking both the pretest and the posttest.
2. For each class, there was no statistically significant difference between the mean of the posttest scores of the group taking the posttest and the mean of the posttest scores of the group taking both the pretest and the posttest.

Given these results, the analyses of these quantitative difference scores ensued.

A One-way Analysis of Variance was performed on the writing assignment difference (posttest - pretest) scores. Also, three planned contrasts were performed.

Figure 1 displays Writing Assignment means and Figure 2 shows the results of the Analysis of Variance.
The homogeneity of variance tests were not significant at an alpha level of 0.05. Thus, the homogeneity of variance assumption of the F test was not violated. Further, the normality assumption for each treatment population was tested. The Lilliefors test was used and four of the ten classes of difference scores were found to be normally distributed at a p value of 0.05. The other six classes of difference scores were visually inspected using normal probability plots. Each of the six classes of data was found to be approximately normally distributed and symmetrical. Monte Carlo studies of the F test suggest it is robust enough to handle deviations from normality when scores are symmetrical (Keppel, 1991).

The overall F test is significant at a p value of less than 0.001. This result provides strong evidence against the null hypothesis. This evidence suggests that it is highly unlikely that the observed differences among the class means happened by "chance". Rather, the evidence suggests that differences among the class means are present.

Because the chance for Type I errors increases as the number of analytical comparisons increase, a modified Bonferroni test was used to verify the significance of the planned comparison results (Keppel, 1991). Thus, for each of the three planned comparisons, an alpha level of 0.016 was used to ascertain statistical significance.

**Planned Contrast 1**

The first planned contrast was constructed to compare the mean of the difference scores of the class receiving the EMS treatment to the average of the mean of the difference scores of all other classes. This contrast was defined as follows:

\[ u_1 = \frac{(u_2 + u_3 + u_4 + u_5 + u_6 + u_7 + u_8 + u_9 + u_{10})}{9} \]

This planned comparison resulted in a t value of 4.498 and a F value of 1.4375. Both values are statistically significant at a p value of less than 0.001. Thus, the EMS class, on the average, had significantly better writing difference scores than the average of the classes without the EMS treatment.

The standardized mean difference for this contrast was calculated as well at \( d = 0.8287 \). The value of \( d \) provides the size of the treatment effect. The magnitude of this effect size would be considered at least "average".

**Planned Contrast 2**

The second planned contrast was constructed to compare the mean of the difference scores of the class receiving the EMS treatment to the average of the mean of the difference scores of all the other classes taught by the same teacher as the treatment group. This contrast was identified to determine whether a teacher effect contributed to the development of stronger writing skills. It was defined as follows:

\[ u_1 = \frac{(u_2 + u_3)}{2} \]

This comparison resulted in a t value of 4.855 and a F value of 1.9514. Both values are statistically significant at a p value of less than 0.001. Thus, the EMS class, on the average, had significantly better writing difference scores than the other non-EMS classes with the same teacher.

The standardized mean difference for this contrast was calculated as \( d = 0.4651 \). The magnitude of this treatment effect size would be considered "average".

**Planned Contrast 3**

The final planned contrast was constructed to compare the mean of the difference scores of the class receiving the EMS treatment to the average of the mean of the difference scores of all the other non-advanced standing classes. The contrast was defined to determine whether a
scoring ceiling effect for the advanced-standing classes contributed to the treatment effect. It was defined as follows:

\[ u1 = (u2 + u3 + u4 + u5 + u6 + u9 + u10) / 7 \]

This comparison resulted in a t value of 4.954 and a F value of 1.6147. Both values are statistically significant at a p value < 0.001. Thus, the EMS class, on the average, had significantly better writing difference scores than the other non-advanced standing classes without the EMS treatment.

Again the standardized mean difference was calculated as \( d = 0.7034 \). This treatment effect size which excludes the advanced standing classes is less than the treatment effect size when all classes are included. Again, it is assumed that this effect size would be considered at least "average".

Student self-assessment writing product and process scores were also analyzed and the results were not found to be statistically significant.

In summary, the Analysis of Variance Summary Table results and the planned comparison results for the quantitative difference scores indicate strong support for hypothesis H1: Classes using EMS developed stronger writing skills than those classes that did not use EMS. Not only was the overall F test statistically significant, but the F value for each of the planned comparisons was statistically significant. Further, the standardized mean difference score for each planned comparison indicates the magnitude of the treatment effect was at least average. Thus, in addition to the detection of a significant difference between the treatment and control groups, the magnitude of the treatment effect was found to be substantial. Many researchers regard treatment effects of "average" strength to be meaningful and worthy of study (Keppel, 1991).

Even though the statistical results of the self-assessment difference scores did not support H1, these results should be given less weight because they are based on a subjective rather than an objective measure.

Case Study Findings

Throughout the data collection process, the field notes and interview transcripts were revisited. In addition, a second researcher was called upon to observe several traditional and several GroupSystems class periods. In light of this study's research questions, repeated topics and patterns of data emerged. These findings were consistent with the second researcher's observations. This iterative analysis process led to coding categories and subcategories. The coded field notes and interview transcripts were analyzed and numerous themes emerged. The following discussion presents these findings.

In the EMS classroom, a cooperative learning environment emerged where students consistently worked together and were task focused. In the GroupSystems classroom, the students were consistently engaged and actively participated in classroom activities. They worked cooperatively, in parallel, and at their own intellectual pace. Student sharing and peer teaching became the norm in the GroupSystems classroom. Not only would students share their ideas about the course material, but further they would share their growing expertise about the software. The teacher moved from the role of lecturer to facilitator of the problem-solving process. Students tackled more and bigger problems than permitted by the traditional classroom (i.e., the class novel). Class discipline problems all but disappeared. In addition, the EMS technology provided more opportunities for immediate and frequent feedback.

The student perspective was ascertained by means of formal and informal interviews and via student surveys. The students stated that one major benefit of the EMS-supported classroom setting was the opportunity and support provided for working with other students. They learned how to work with other students and became comfortable with the process of teamwork. Also, the students mentioned that through the consistent, classroom group interaction, they got to know their fellow classmates better than would be possible in the traditional classroom. Further, several students mentioned that because the teacher frequently rotated group membership, they were able to work with and learn from students with whom they would not have chosen to interact. Following are some of their direct comments:

"GroupSystems helped us to know each other and work with other people."
"It helps us to see what others are thinking."
"It helps us to get other student's opinions on our work."
"It teaches kids to cooperate."
"It is easier when we can see what others are writing."
"We all worked together as a group."
"I was able to communicate better."
"The work was done much faster."

Finally, over the course of the school year, many students commented that they were pleased to be learning "this computer system". Students today are aware that they are in the midst of "The Information Age" and they know the importance of being comfortable with and masters of technology. The computer is the "universal tool" for these students and they are eager to learn anything and everything they can about it. The
GroupSystems classroom provided them with another opportunity to learn about technology.

Lessons for the Teacher

After a year of trials and errors using GroupSystems in the classroom, several important lessons for the teacher can be stated. These involve lesson design, curriculum support, and accountability.

Lesson Design

In a traditional classroom, it is possible and quite commonplace for a teacher to realize during the lesson that things are not going well. All teachers have had the experience of changing the plan in mid-stream for one reason or another. However, this is more difficult when using GroupSystems. Any lesson using the software takes time to prepare as far as tools to use, the time for each, and the expected outcomes.

For example, in a writing lesson using multiple sessions simultaneously, changing from one tool to another required several minutes, and students quickly lost patience and attention to the task. Spontaneity is more difficult under those circumstances.

For GroupSystems class sessions, preplanning and exploring various potential scenarios beforehand seemed to reduce classroom stress. Further, it gave the instructor time to reinforce and rehearse her new role.

Curriculum Support

Another lesson to teachers is the challenge to use the system to support the curriculum. GroupSystems is an especially effective tool for solving complex problems, and it is tempting to watch students grapple with "real-life" situations such as solutions to problems around the school or answers to social challenges. These real-life situations are a good way to break up the routine or to bring relevancy into the classroom. However, as any teacher knows, the district curriculum must also be followed.

Two suggestions arise for using GroupSystems to support the curriculum instead of supplanting it. The first is to adapt the tool to the curriculum. GroupSystems includes brainstorming activities, organizational tasks, and writing and editing assignments. Votes and priorities can be established on the system, and solutions to classroom problems can be examined with the software. Obviously, the field is wide open to discover new ways to apply GroupSystems to any established curriculum.

A second suggestion for incorporating GroupSystems into the curriculum is just the opposite, to adapt the curriculum to the tools. Knowing the various possibilities for tool use will often guide a teacher into a creative support for a curricular concept. Students seem eager and never jaded by using computers in the classroom, especially when they are linked together electronically, making assignments more cooperative.

Accountability

A third lesson involves the accountability of the students when using GroupSystems. On one hand, students at every age and maturity level seem compelled to take advantage of the anonymity factor by "flaming", writing irrelevant and/or inappropriate comments. These can range from mildly embarrassing to outright insulting. It seems to occur in any class, regardless of the maturity level of the students.

There are several ways to address this seemingly inevitable issue of flaming. The "hands-off" approach, that is to let it flame and burn out on its own, is unacceptable to some teachers. A more proactive approach is to discuss beforehand the necessity of self-control and sensitivity to other people in the classroom. Another is to give students permission to ask the facilitator to delete writing which he/she finds offensive. Still another idea is to require students to sign in using their matriculation number or a pseudonym before any brainstorming activity. That way, ideas are still anonymous to class members, but can be traced by the teacher if necessary. Of course, in final desperation, the teacher can simply threaten to or actually terminate the activity. Usually the students enjoy working with GroupSystems enough that they police themselves and retain the opportunity to work in the lab.

Along with accountability comes the question of how to give credit to individual students when the whole class is working via the system. It would be very easy for a few students to simply watch the action and go along for the ride. Usually their enthusiasm for working on computers and their curiosity at seeing their comments in front of their classmates eliminates this problem. However, a student sign in by matriculation number or a code name also allows the teacher to find any slackers in the class.

A final lesson for the teacher has been alluded to already, and that is that the field is wide open. Some activities will be more successful than others, of course, but the potentials are unlimited. Teachers and students alike will grow with the system as it becomes more familiar to everyone. As more teachers use this technology in their classroom, new ways to incorporate the software into lessons will be uncovered, and those new ideas will stimulate still others.
The Future

As GroupSystems itself becomes more mature, it will be used beyond the same-time, same-space mode. It can be used useful with different-time, same-space activities, allowing students to work on interclass projects. It can be used in the same-time different-space method, allowing classes across the country to join in projects. Finally, it can be used for different-time, different-space activities, encouraging intercontinental experiences.

The results of this study suggest that the incorporation of EMS technology in the classroom fosters a more effective learning environment. The potentials for GroupSystems in the classroom are limitless. Classroom use could conceivably become as important as business use. Computer support for group work could easily revolutionize the classroom as profoundly as personal computers have done up to now.

References


