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ABSTRACT

Human resource positions that are becoming known as Technology Coordinator (for district-level personnel) and Technology Resource Teacher (for school-level personnel) have been created to help integrate technology into classroom instruction. This study assessed the progress and effectiveness of Technology Resource Teachers, or TRTs, as technical and instructional support persons. Their roles and responsibilities were examined to identify any changes in their positions or their approaches to achieving their long-term goals. The study also compared its new results with previous results in order to identify the future roles of instructional technologists in public schools. Data collection methods included: interviews with TRTs; classroom, computer lab and site observations; public and personal records, reports, and documents; and teacher questionnaire and attitude surveys. The study was conducted in six middle schools in the southeastern United States. Results indicated that the TRTs were generally successful in establishing and maintaining a computer lab in their respective schools. The support of TRTs was instrumental in increasing their teacher constituents' confidence in their own computer skills and usage of their home computers. Teachers, however, did not yet show any major improvement in their attitude toward or usage of computers in classroom instruction--despite receiving regular training and technical support. On the whole, teachers' positive perception of TRTs and their role at the school, combined with the improvement in teachers' computer competency skills across the schools, are indicators of the TRTs' progress in their effort. A series of tables present the study results. (Contains 20 references.) (AEF)

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Instructional Technologists at Public Schools:A Study of the Role and Effectiveness of Technology Resource Teachers

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Introduction

Without doubt computer technology can enhance education, but it is most powerful when it is truly integrated into the curriculum. Effective use of computers in the classroom requires curriculum transformation in the schools, which in turn requires technically and instructionally well-prepared teachers. Reports made on computer usage state that increased availability of computers does not always lead to improved utilization. In spite of the increasing number of computers in schools (Ely, 1989; U.S. Congress, 1995), not many practicing teachers feel that they have adequate training to enable them to integrate computer technology into their curriculum and instruction (Faison, 1996). Recent research on the role of teachers in adoptation of computers into their instruction highlights several factors that influence teachers' usage of computers. These factors include: (1) the adequacy of teachers' training in computer use, (2) the level of administrative support they are likely to receive, (3) the presence or absence of curriculum constraints, and (4) teachers' personal preferences (Beaver, 1990; Cuban, 1989; Stover, 1990; Wiske, et al., 1990). Of all these factors, adequate teacher training in computer use (Gressand & Loyd, 1985; Phillips, Nachtigal, & Hobbs, 1986; Thompson, 1985; Wilkinson, 1980) remains to be the most influential and among the highest needs of schools (Stiegemeier, 1995).

Another body of literature on school staff development training in microcomputers indicates that training workshops or formal coursework in computers do not solely affect teachers use of computers (Sibalwa, 1983). There needs to be a careful and systematic plan for training teachers at the school and district levels with respect to integration of computers and related technologies in the curriculum (NASSP, 1994). Reports also point to the need for on-going, site-based technical and instructional support systems for teachers to ensure the continuous use of computers and related technology (e.g., Brennan, 1991; Fulton, 1988; Wisconsin, 1990).

During the past few years, many school districts around the country have responded to the above needs by developing a district-wide plan for the integration of computers and related technologies into the curriculum. A part of this plan has been to establish a district and a school-based technical and instructional support system to assure the proper usage of computer technology for instructional purposes. This attempt has also resulted in the creation of a position that seems to expand the utilization of media and library resources (as used by media specialist), and requires skills and knowledge in instructional technology. This new human resource position is entitled Technology Coordinator (at the district level) or Technology Resource Teacher ("TRT") at the school level, and is responsible for helping the district or the school integrate technology into classroom instruction. It is interesting that the public schools are now beginning to acknowledge the pool of educators who have been trained in instructional design and technology after decades of overlooking the need for their role. The result of this attempt by the public schools is extremely important in shedding light on the need for the instructional technologist in the schools, and to the future role of the instructional technologist in the public school.

During Spring and Fall 1995, Moallem, Mory and Rizzo (1996) conducted a study to identify the roles and responsibilities of a group of TRTs at the middle school level in a school district in southeastern North Carolina. This study examined the extent to which the TRTs have been successful in helping classroom teachers use and integrate computers in their curriculum and instruction. The study investigated how technology resource teachers' roles differed from those expected of instructional designers/technologists. The results of this study suggested that although TRTs reported that they spent 75% of their time on technical support, the nature of the TRTs' role was more instructional than technical. In addition, the above study indicated that the TRTs' long term goals were to assist teachers integrate technology into their classrooms and to train teachers to train students in computer usage.

The result of the above study also demonstrated that TRTs were able to develop a positive and collegial relationship with teachers in order to help them integrate technology. However, it did not show whether the teachers' attitude, their usage of computers, or their classroom practice had changed as a result of TRT's support. This was especially important since the above study indicated that the TRTs did not appear to have the skills and knowledge that an instructional technologist would have if he/she were in this position. It should be noted that the TRT

position was first instituted in September 1994, and the above research study was conducted at the end of the first year of the institution of the computer competency program and the TRT position.

The Purpose of the Study

The purpose of this study was to assess the progress and effectiveness of TRTs, as technical and instructional support persons, in their effort to assist classroom teachers to integrate computer technology into curriculum and instruction. It examined the roles and responsibilities of TRTs to identify any changes in their roles and approaches in achieving their long-terms goals. It also aimed to compare the new results with the previous results (Moallem, Mory and Rizzo, 1996) in order to identify the future roles of instructional technologists in public schools.

The study specifically focused on the following questions:

- How did the role of TRT change over time (from the first year to the second year)?
- What problems did TRTs encounter in helping teachers integrate technology into their classroom? and What strategies did they use to alleviate the problems?
- How were TRTs perceived by teachers? and What effect did the TRTs have on the teachers' integration of computers into their curriculum and instruction?
- How did the teachers feel about computer technology, and was there any change in their attitudes toward the computer and its usage in the second year?
- What was the level of usage of computers by teachers, and how did it change over the past year?

Methodology

The study was conducted using an explanatory case study approach within a naturalistic paradigm utilizing both qualitative and quantitative methods of inquiry (Yin, 1994). We perceived this approach to be appropriate for the questions that we asked. We employed a multiple data collection technique to triangulate the information from different sources and to ensure accurate portrayal of reality. By using this approach, we were able to employ multiple data-gathering methods. Since we intended to compare the data of the first year with the data of the second year to determine the change, we collected data using similar methods and schedule at the end of first and the second years. The data-collection methods included:

- informal and formal interviews with technology resource teachers,
- classroom, computer lab and site observations,
- public and personal records, reports and documents, and
- teacher questionnaire and attitude surveys.

Due to the limitation of time and resources and because the program was first conducted at the middle school level, as with the first year study, we focused on the middle schools in the county (six in total). Our data collection procedure began in early February and continued until early September, 1996. From February to March, 1996 we interviewed the TRTs and observed the computer facilities and computer labs in each school. During the month of May, 1996 we observed computer labs while in use by classroom teachers. We also administered the same surveys which we used at the end of the first year. The General Information Survey (the "general survey") was constructed by the researchers around the major questions of the study, and the Computer Literacy Attitude Survey ("CLA") was adopted (Savenye, 1992; Savenye, Davidson, & Orr, 1992). Both survey instruments were completed by teachers following one of their respective school's professional development meetings. 187 teachers responded to the CLA survey (compared to 206 in the first year), and 217 teachers answered the general survey (compared to 176 in the first year). The return rate for both the general survey and the CLA survey was between 90-95% for two of the schools, and was between 55-71% for the other four schools.

The general survey consisted of 18 closed-ended and 9 open-ended items. The closed-ended items asked about teachers' computer facilities at home and the classroom, their usage of their computer facilities, their previous and present computer training, the computer competency tests, and their feelings about their computer skills. The open-ended items, on the other hand, asked teachers about their perception of the role and responsibilities of the TRT, and the type of help that teachers received from the TRT in their respective schools. The CLA survey consisted of 50 Likert-scale type items which were developed and used by Savenye and her colleagues (Savenye, 1992; Savenye, Davidson, & Orr, 1992) to measure attitudes of preservice teachers towards computers. The items were related to

liking computers, valuing computers for society and education, anxiety about using computers, confidence with regard to learning and using computers and perceptions of gender appropriateness of computers. Teachers were asked to rate the items from "Strongly Agree" to "Strongly Disagree". In addition to Likert-scale items, teachers were also asked several background questions. The items were slightly modified to be used with in-service teachers. In addition to the Likert-scale items, teachers were asked several questions about their background and the number of hours that they had participated in computer training workshops.

Data Analysis

We analyzed the data using both qualitative and quantitative analysis techniques. Interview and observation data and the results of the open-ended questions from the general survey were analyzed qualitatively using the Miles and Huberman (1984) model. Based on this approach, the first part of the analysis was data reduction. During this process, the data chunks were identified and coded, the patterns that best summarized a number of chunks were sorted and then were further subsumed into larger patterns. In some cases, the data were organized using the frequency of the responses to specific questions or by the pattern of responses. In such cases, however, the numbers were used together with the words to keep the data in its context. During the second analytical stage, the data were summarized and organized using matrices, charts and tables. This stage helped the researchers interact with the data and draw their preliminary conclusions, which in turn triggered another round of testing and verification using different sources of the data for the final conclusion.

The results of the closed-ended items of the general survey and the CLA survey were analyzed quantitatively. Descriptive statistics, cross tabulation, Chi-square, and Multivariate Analysis of Variance ("MANOVA") were used for this part of the data. Since the number of teachers who responded to the two surveys were not equal across the schools, we randomly selected an equal number from each school to conduct cross tabulation, chi-square and MANOVA.

Results

Description of the School District and the Technology Initiatives

The study was conducted in all of the middle schools (a total of six) within a city district in the southeastern United States. The district is within a zone that draws from affluent neighborhoods, as well as from neighborhoods of racially- and ethnically-mixed working- and low-class families.

In 1992, the State of North Carolina Department of Public Instruction put together a set of computer skill competencies as a basic requirement for public school teachers and students. In anticipation of this state technology initiative requiring all schools to integrate technology into their classrooms and all teachers and students to pass a technology competency test, the district Technology Coordinators designed a plan to enable the teachers and students in the district to attain the necessary computer skills in accordance with the state technology initiative. The elementary schools in the district already had a designated classroom teacher to act as a technology resource person, and the elementary classroom teachers were already using technology in the classroom to some degree. The middle schools in the district, however, were not set up with such a situation. The mandate included a timeline to eventually administer a test to all eighth graders in the state to insure that the students had met the minimum computer skills. It was imperative, therefore, that the middle school teachers and students be targeted for broader technology support.

The TRT position was created to provide technical and instructional support at the school level to help teachers integrate technology into their curriculum and classroom practices, and to assist teachers in passing the technology competency test required by the state. This position was created to be different from the media specialist position which already existed in most schools. The role of the TRT differs from that of the media specialist because the TRT was expected to be responsible for integration of computer technology into classrooms, while the media specialist was responsible for library media and providing print and media support at the school library. Two Technology Coordinators at the district level were in charge of developing a strategic plan and a job description for the TRT position and helping principals hire the qualified individuals. These two coordinators were also in charge of preparing the TRTs for their job responsibilities by providing them with training workshops and proper technical and administrative support.

Technology Resource Teachers (TRTs)

Out of the six original TRTs, two left their positions at the end of the first year, and these positions were filled by two new individuals from within the respective school. The educational background of the TRTs spans from 1-22 years of teaching experience. The majority of them have a background in teaching math (66%), science (16.6%), or special education (16.6%). Four of the TRTs were classroom teachers in their respective schools before being appointed to this position. The other two TRT were hired from outside the school. In general, the TRTs' background in computer training incorporates college courses and in-service training workshops (50%), job related experiences (33.3%) and self-learning/practices (16.7%). Each of the TRTs have passed the computer competency test required by the state of North Carolina. Their reasons for becoming TRTs include an interest in technology and teaching. None of the TRTs, however, have had any training or college courses in instructional design and technology. They also have not had any training and/or experience in analysis, design, development and/or evaluation of instructional materials and/or programs.

How did the TRTs' role change over time ? What problems did TRTs encounter in helping teachers integrate technology in their classroom and what strategies did they use to alleviate the problems?

The observation, interview and questionnaire data showed that the nature of the TRTs' role remained mainly the same as compared with the first year. All six TRTs continued to maintain the computer lab operation (technical support) and to provide training workshops for teachers and students (instructional support). However, the focus of the TRTs' responsibilities changed by the end of the second year. Compared to the first year in which the TRTs spent more time on technical issues (75%), rather than instructional (25%). By the end of the second year they reported spending more time on instructional matters. Moreover, the TRTs' main emphasis on training teachers to pass computer competency tests shifted to preparing students, particularly eighth graders, to take the computer competency test in the second year.

Analysis of other sources of the data provided explanation for this change. Since a large number of teachers were able to pass the computer competency test at the end of the first year, the TRTs were able to redirect their focus to provide training for students in the second year. In addition, since the number of teachers who were able to integrate technology into their classroom was still very low (between 2 to 5 individuals in each school) by the second year, the TRTs assumed the responsibility of preparing eighth graders for computer competency test in accordance with the state requirements.

As with the first year, the main focus areas in the second year's computer workshops were: database, word processing and spreadsheets. Terms and operations, keyboarding, societal uses, and ethics were also taught. The percentage of teachers across six schools who received 30-40 hours of training workshops increased from the first year (28.4%)to the second year (37.8%) by 9.4%. Although no significant difference was found among the schools with respect to the number of training workshops teachers completed in the first year, there was significant difference among the schools in the second year (Chi-square = 6.7, $p < .01$). This result indicates that teachers in some schools completed more training workshops than in other schools in the second year. The interview data attests that the difference was due to several factors: (a) TRT's plan of action, (b) principal's emphasis on competency test, and (c) lower number of teachers who passed computer competency test.

Analysis of data collected in the first year showed that in response to the question "In what ways has the TRTs helped you with computer usage?" teachers listed the following items as the major areas of assistance: (1) find/update software, (2) available to help with what they need, (3) teach them how to use computer or pass computer competency test, (4) help with staff development and workshops, (5) troubleshoot, and (6) answer questions about technology. Analysis of data collected in the second year showed slightly different answers for this question. While teachers still listed the above areas of need, the majority of those who responded to this item (19.9%) indicated that TRTs helped them integrate technology into their teaching and lesson planning. Another difference was also related to TRTs' assistance with computer competency test training. In the first year more teachers (15.2%) reported that the TRT helped them in computer competency test training than did teachers in the second year (7.4%). These differences demonstrate the change in the TRTs' instructional role from the first year to the second year. As TRTs mentioned, since a greater number of teachers passed the computer competency test in the second year, TRTs did not see any need to provide more assistance in computer competency training. Instead they were able to focus more on integration of computers in the classroom.

The analysis of data in the first and second years showed that The TRTs' primary instructional strategy for accomplishing their goals remained more or less the same. TRTs provided training workshops for teachers and tried

to model the teaching of the various computer competencies to students through an integrated lesson (e.g., language arts, mathematics, social studies, and science). The TRTs taught the majority of integrated lessons while the classroom teachers were present to help or to observe. In a few cases, the teachers themselves taught the integrated lessons with the TRT available to assist.

At the end of both the first and second years TRTs were asked what problems they encountered in helping teachers to integrate technology. Their responses encompassed the following problems: (a) teachers' expectations of TRTs to assume responsibility for teaching technology to students, (b) teachers' resistance to learn and use computers, (c) teachers' intimidation by computers, and (d) lack of proper hardware and software for teachers to use. Each TRT also reported using different strategies to solve the above problems. For example, some TRTs chose strategies such as: (a) providing more workshops (to increase teachers' computer skills), (b) giving more concrete examples and developing more meaningful activities for computer usage, (c) trying not "to step on teachers' toes" and proceeding slowly, and (d) adding a sense of humor to make the process more comfortable. Some others took a more punitive approach by using strategies such as : (a) demonstrating to teachers the consequences of their resistance, (b) removing their classroom computers until they learned the skills, and (c) asking administrators to pressure teachers to take more responsibilities.

How were TRTs perceived by teachers, and what effect did TRTs have on the teachers' integration of computers into their curriculum and instruction?

Comparison of teachers' perceptions of TRTs over the two-year period revealed that although there were some differences in the way teachers at each school perceived TRTs, there was more commonality than difference in their perceptions. For example, in the first year, the majority of teachers at each school described the TRT as someone who: (a) provides computer training or workshops for teachers and students, (b) assists in learning computer competencies or computer usage, (b) is always there to help them, and (c) is a problem-solver or a trouble shooter. In the second year, teachers still perceived the TRT as providing instructional support, helping teachers and students with learning computer competencies and as a helper and trouble shooter.

TRTs were also asked to describe their perceptions of their roles and responsibilities. Comparison of the statements used by each TRT to describe his/her role over time revealed some differences. For example, at the end of the first year, the majority of TRTs (83%) believed that their role was more technical than instructional. They indicated further that they spent 70% or more of their time providing technical assistance and support (e.g., setting up and maintaining the lab, troubleshooting, installing software and hardware), and only 30% or less of their time providing instructional support. However, TRTs' statements of their role in the second year indicated that they saw their role as being more instructional than technical. All of the TRTs indicated that their role was to provide workshops for teachers and students, help teachers integrate technology, teach in the computer lab and/or support teachers in their attempts to integrate technology.

How did the teachers feel about computer technology, and was there any change in their attitudes toward the computer and its usage?

A total of 206 teachers across the six middle schools completed the CLA survey at the end of the first year, and a total of 187 teachers completed CLA survey at the end of second year. The CLA survey contained items related to liking computers ($r = .80$), valuing computers for society and education ($r = .62$) ; anxiety about using computers ($r = .91$); confidence with regard to learning ($r = .67$) and using computers ($r = .73$); and perceptions of gender appropriateness of computers ($r = .47$). Teachers were asked to rate the items from "Strongly Agree" to "Strongly Disagree". In addition to Likert-scale items, teachers were also asked several background questions.

Appendix A summarizes the means of all teachers' responses to the CLA survey over a two-year period. As mean scores show teachers' attitudes improved slightly in some areas. For example, teachers seemed to like computers better (24.36 to 25.57) and to have less anxiety about using computers (27.74 to 27.95) and more confidence about learning computers (3.38 to 3.42). However, teacher's attitudes did not improve, and even declined in some other areas. For example, teachers did not seem to have more value for computers in education (55.39 to 54.52), or the society (10.7 to 10.6) and did not change in their confidence about using computers (4.09 to 3.96). Teachers' perceptions of gender differences in computer usage also did not show any improvement (19.8 to 19.72).

We examined differences in five measures of attitude across dependent variables, such as: different schools, the usage of computers in the classroom, different levels of previous computer experiences, and different levels of previous and present computer skills using MANOVA. Appendix B shows the means and standard deviation for

each dependent variable and for each year. The result of the multivariate and univariate F values with significance at the .05 level or greater are also presented in Table 1 and 2

As Table 1 and 2 show, there was no significant main effect in the variables, such as: liking computers, value for computers in education, confidence for learning and using computers, and anxiety for computers across different school in both years.

We also tested differences in the usage of computers across the five measures of attitude. Appendix B shows means and standard deviations for each dependent variable in the different years. As Tables 1 and 2 show, the MANOVA yielded a significant main effect [Wilks' Lambda = .9, $F(5, 122) = 10.5$, $p < .05$] for the first year and no significant main effect for the second year. The univariate analysis showed that teachers who were currently using computers in their classroom liked computers more in both the first year and the second year and had more value for computers in education in the first year. The anxiety and the confidence for using computers were not significantly different for those who used or did not use computers in their classrooms in the first year. However, the analysis of univariate for the second year showed teachers who were currently using computers had more confidence about using computers and had less anxiety about computers.

Tables 1 and 2 show that MANOVA yielded a significant main effect for previous computer experience for both first year [Wilks' Lambda = .6, $F((5, 122) = 2.6$, $p < .001$] and the second year [Wilks' Lambda = .4, $F(5, 108) = 4.1$, $p < .001$]. The univariate analysis revealed that both in the first and second years, teachers who had previous computer experience liked computers more , had more confidence in learning computers, had more confidence in using computers, and showed less anxiety about computers.

As shown in Tables 1 and 2, MANOVA yielded a significant main effect for rating computer skills before the school year in both the first [Wilks' Lambda = .5, $F(5, 122) = 3.9$, $p < .001$] and second years [Wilks' Lambda = .5, $F(5, 108) = 3.6$, $p < .001$]. The univariate analysis indicated that in both the first and second years, teachers who rated their computer skills high before the beginning of the school year: liked computers more, had more confidence in learning and using computers and had less anxiety about computers. However, analysis showed no significant difference in value for computers in education for either years.

Finally, as Tables 1 and 2 reveal, MANOVA yielded a significant main effect for rating present computer skills in both the first [Wilks' Lambda = .4, $F(5, 122) = 5.3$, $p < .001$] and second years [Wilks' Lambda = .4, $F(5, 108) = 4.8$, $p < .001$]. The univariate analysis showed that in both first and second years, teachers who had rated their present computer skills high liked computers more, had more confidence in learning and using computers and had less anxiety about computers. However, the univariate showed no significant difference in value for computers in education for either year.

How did teachers feel about their knowledge and skills in computers? What was the level of usage of computers by teachers, and how did it change at the end of the second year?

The general survey was completed by a total of 176 teachers in the first year and 217 teachers in second year respectively. The comparison of the results from the two years showed an increase in the number of teachers who have a home computer (51.5% to 58.5%) and are using their home computers for either school (50.6% to 55.9%) or personal purposes (51.7 to 53.0). The results also indicated an increase in the number of teachers who completed between 30-40 hours of training workshops (28.4% to 37.8%) and those who passed different areas of the computer competency test (see Table 3). Significant relationship was also observed between the hours of training workshops received and the teachers' confidence about their computer skills (Chi-square = 16.4, $p < .001$). A high percentage of teachers who completed between 30-40 hours of computer workshops indicated that they felt confident about most of the computer skills.

However, with respect to the classroom computers, although TRTs indicated that almost all teachers in their respective schools had at least one computer in their classrooms, a lesser number of teachers reported having computers in their classroom in the second year (85% to 63.6%). The teachers' responses to open-ended questions were consistent with this finding. When teachers were asked to describe any problems that they had with respect to computer integration in their classroom, the majority of those who responded listed a limited number of computers in their classrooms as a major problem. The discrepancy between the TRTs' and the teachers' reports as well as in the teachers' reports for the first year and the second year, can be explained by the teachers' lack of skills and knowledge about computers in the first year. Teachers lack of knowledge and skills might have been the reason that they were not able to distinguish incompatibility of their classroom computers in the first year, thereby reporting more computers in their classrooms.

Teachers were also asked to describe how they used computers in their classrooms. Interestingly enough, the results indicated that except for preparing hand-outs and printing materials, less teachers reported using computers in their classroom in the second years (see Table 4). The number of teachers who reported having educational software in their classroom also decreased (64.2% to 46.1%). The decrease in the usage of the classroom computer could be due to the incompatibility of the classroom computers with the computers in the lab, or due to the availability of the computer lab for classroom instruction.

Usage of computers in the classroom varied slightly from one school to the next. In the first year the majority of the teachers indicated that they were mainly using computers for word-processing and subject-matter software. Enrichment/remediation and keyboarding ranked as the third and the fourth most common applications of computer usage in the classroom. However, in the second year, those teachers who were using their classroom computers reported that they were using their computers mainly for enrichment and/or remediation (17.1%), word-processing (10.7%), and presentation/grade/individualized programs (10.7%). This result is consistent with the result of the closed-ended items which asked a similar question. The highest percentage of the classroom computer usage was for printing materials, enhancement of learning, and enrichment/remediation. The interview and observation data also revealed that when attending computer labs, students primarily used word-processing, games and subject-specific software for remediation.

Teachers were also asked to rate their computer skills in order of strongest to weakest. The results were similar for the first and second year. Teachers across different schools rated their word processing skills as the strongest computer skills and telecommunications as their weakest. When asked to explain why they had chosen some areas as their weakest areas, in the first year teachers listed factors such as lack of time and training. In the second year, in addition to lack of time and training, they also included factors such as lack of practice and experience in those skills, lack of confidence in their skills and less need for those skills.

Teachers' level of confidence in computer competency skills were also assessed. When teachers were asked to describe their confidence in computer competency skills at the beginning of the school year, 17.0% reported that they had all of the required computer competency skills in the first year. At the beginning of the second year only 20.1% of teachers thought that they had all of the required computer competency skills. However, when asked to describe their computer competency skills at the end of the second year, almost half (47.2%) of teachers reported that they had confidence in all of the required computer competency skills.

Discussion

The purpose of the study was to assess the progress and the effectiveness of TRTs in their effort to assist classroom teachers to integrate computer technology into their curriculum and instruction. As the results indicate, TRTs were successful in establishing and maintaining a computer lab in their respective schools. They were also successful in providing regular training workshops and assisting teachers pass the computer competency tests mandated by the state. The improvement in the teachers' level of confidence in computer skills and the increased number and usage of home computers by teachers can also be attributed to TRTs instructional support.

However, based on the findings of the study, teachers did not show any major improvement in their attitude or usage of computers in their classroom instruction despite receiving regular training and technical support. This is contrary to the findings of the studies that suggest computer training can lead to a more positive attitude toward computers (e.g., Ernest & Lightfoot, 1986, Gressand & Loyd, 1985, Thompson, 1985). Furthermore, the study suggests that the number of teachers who were able to integrate technology into their curriculum and instruction remained unchanged. The slight improvement in teachers' attitude can be explained by their lack of computer usage and computer integration in the curriculum. This is again inconsistent with the findings of Day and Scholl (1987) that teachers' attitudes toward technology could be changed through organizational support and training. In the present study, TRTs as instructional and technical support were not successful in improving teachers' attitude beyond a certain level over a two year-period. As the review of other studies suggests (Chin & Hortin, 1993), this inconsistency can be due to the teachers' need for ample time to acquire the knowledge, understanding and skills in instructional technology before they begin to use and integrate it into their curriculum.

Consistent with numerous studies, the results of MANOVA tests in this study confirm that teachers who are currently using computers in their classrooms tend to like computers more, show more confidence in learning and using computers, and have less anxiety about computers. Furthermore, teachers who rate their computer skills high show a more positive attitude toward computers. Therefore, one can assert that there is a positive relationship between attitude and computer usage. Once teachers master the skills and begin using computer technology in their classroom and integrate it into their curriculum and instruction, their attitude will improve.

Another important finding relates to the strategies that TRTs used in helping teachers integrate computers into their classrooms. Since not many teachers used or integrated computer technology into their classroom, it is hard to assess the effectiveness of the TRTs' strategies in instructional support. The two most frequent strategies used by TRTs to help teachers acquire computer competencies were: making training a top priority at the school level and requiring teachers to take responsibility in learning and using computers. Anderson and Odden (1986) also reported the importance of making training a priority in order to enhance teachers' desire to commit to learn and to become successful in educational technology.

Finally, the study suggests that despite the limited number of teachers who were able to use and integrate computers into their curriculum and instruction, TRTs made progress in their long-term goal. Teachers' positive perception of TRTs and their role at the school combined with the improvement in teachers' computer competency skills across the schools are indicators of the TRTs' progress in their effort.

Based on the findings of the study, it seems that if teachers are to integrate computers in their curriculum the following factors must be taken into account.

1. Organizational support plays an important role in any technological transformation within a school system. As the findings of this study suggest, organizational support must be provided at different level in order to assure the implementation of any technological innovation. The systems outside schools including districts, community and state can support the technological transformation by establishing requirements for computer integration. For example, in this study, the state mandated computer competency tests established the need for planning new goals and providing instructional and technical support. Without this organizational requirement, whether or not TRTs would experience any success in their efforts is not certain.
2. Teachers needs ample time and training in order to acquire knowledge and understanding of what instructional technology can do for them. It seems that on-site training should continue for a long period of time if teachers are to integrate computer technology into their instruction and transform their curriculum. The training workshops must concentrate more on subject areas and grade levels. Teachers need to have a greater say in the nature of the activities and workshops topics. TRTs' ongoing assistance needs to continue until teachers build a higher level of confidence and competence and are less intimated by the computer technology.
3. Accessibility of computer technology in the classroom is as important as accessibility of computer labs. As teachers in this study indicated, technological availability in the school (computer labs) is not enough. Teachers also need to have access to computers and other current technologies in their classrooms or teachers' work stations in order to begin using them. Although a centralized computer lab is very important in assisting teachers learn computer skills and in helping them use it to teach students, a classroom computer encourages a teacher to use it more often with student. Establishing a technology production center that houses the peripherals (e.g., scanner, camcorders, and digital cameras) for teachers is also important, especially when teachers begin using multimedia.
4. Finally the extent to which TRTs are prepared to face the problems and provide immediate solutions and assistance is critical . A knowledgeable, well-trained and well prepared TRT who keeps himself/herself updated in instructional technology is an essential part of the present organizational support system for computer integration. There needs to be an on-job and or in-service training program for TRTs in both instructional technology and instructional design in order to keep them updated in their knowledge and skills. The field of instructional technology can provide leadership in this area. Time finally seems to be ripe for instructional technologists to offer their expertise to the public schools.

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Table 1. Multivariate analysis of variance for teacher's attitude toward computers school, usage of computer, previous experience and rate of previous and present computer skills in first year.

Univariate F Ratio **Multivariate Tests of Significance**		Factors measuring teachers' attitude toward computers				
Source	F Value	1	2	3	4	5
1. Attitude by school	1.1	1.5	0.4	1.6	0.7	1.3
2. Attitude by usage of computer	3.3*	10.5**	7.4**	0.5	1.8	1.2
3. Attitude by previous computer experience	2.6***	9.3***	0.8	2.9*	12.1***	8.2***
4. Attitude by rate previous computer skills	3.9***	13.1***	0.8	6.8***	21.2***	15.7***
5. Attitude by rate present ability to use computer	5.3***	17.0***	0.4	16.9***	37.1***	22.6***

Note: Analyses are on (1) liking computers, (2) value for computer in education, (3) confidence learning computers, (4) confidence using computer, and (5) anxiety for computers.
1 df= 5, 122 2 df= 1, 126 3 & 4 df= 4, 123 5 df= 4, 123
* p<.05 **p<01 ***p<.001

*Table 2. Multivariate analysis of variance for teacher's attitude toward computers school, usage of computer, previous experience and rate of previous and present computer skills in **second** year.*

Univariate F Ratio **Multivariate Tests of Significance**		Factors measuring teachers' attitude toward computers				
Source	F Value	1	2	3	4	5
1. Attitude by school	1.0	0.9	0.8	0.3	0.9	0.9
2. Attitude by usage of computer	1.9	6.3**	0.6	3.4	8.1**	9.0**
3. Attitude by previous computer experience	4.1***	8.5***	2.1	6.3***	12.1***	15.1***
4. Attitude by rate previous computer skills	3.6***	10.1***	0.6	8.6***	14.4***	16.7***
5. Attitude by rate present ability to use computer	4.8***	16.5***	1.6	18.8***	21.4***	23.2***

Note: Analyses are on (1) liking computers, (2) value for computer in education, (3) confidence learning computers, (4) confidence using computer, and (5) anxiety for computers.
1 df= 5, 108 2 df= 1, 111 3 & 4 df= 4, 108 5 df= 4, 108
* p<.05 **p<01 ***p<.001

Table 3. Cross tabulation and comparison of computer competency exams taken by teachers by school and by year.

			Schools					
Question		**Year**	**1**	**2**	**3**	**4**	**5**	**6**
		First	(n=17)	(n=17)	(n=17)	(n=17)	(n=17)	(n=17)
		Second	(n=24)	(n=24)	(n=24)	(n=24)	(n=24)	(n=24)
How many hours of computer workshops have completed?		First	16.0	17.0	16.0	17.0	17.0	17.0
		Second	16.9	16.9	16.9	16.9	16.9	15.5*
Which of the following computer competency exams have you taken?	**Total**							
• Keyboarding	38.1	First	14.3	25.7	8.6	11.4	11.4	28.6
	87.6	Second	17.7	17.7	17.7	16.9	15.4	14.6
• Operating	27.1	First	19.2	34.6	4.5	13.6	9.1	13.6
	80.2	Second	19.2	15.0	20.0	16.7	15.8	13.3
• Word-processing	28.4	First	22.7	36.4	4.5	13.6	9.1	13.6
	84.8	Second	18.1	16.5	18.1	17.3	16.5	13.4
• Spreadsheet	29.5	First	23.1	30.8	3.8	7.7	11.5	23.1
	87.6	Second	17.7	17.7	17.7	16.9	14.6	15.4
• Data base	25.0	First	23.8	42.9	0.0	4.8	9.0	19.0
	81.1	Second	19.0	15.7	19.8	17.4	14.0	14.0

Number 1 to 6 represents different schools

* Indicates results significant (chi-square = 6.7 with 15 degrees of freedom, $p<.001$)

Table 4. Comparison of means and standard deviations of teachers' different computer skills by school and by year.

Question	Year	Schools 1 (n=17) M (SD)	2 (n=17) M (SD)	3 (n=17) M (SD)	4 (n=17) M (SD)	5 (n=17) M (SD)	6 (n=17) M (SD)
	First / Second	(n= 24) M (SD)	(n= 24) M (SD)	(n= 24) M (SD)	(n=24) M (SD)	(n= 24) M (SD)	(n= 24) M (SD)
List the following computers skills in order of your strongest areas to your weakest area (1= strongest and 9= weakest)							
• Terms and operations	First	2.7 (1.9)	4.4 (2.3)	3.0 (2.0)	3.4 (1.6)	3.8 (2.3)	4.6 (2.6)
	Second	3.7 (2.2)	4.6 (2.0)	3.3 (2.2)	3.7 (1.7)	4.0 (1.9)	4.5 (2.2)
• Keyboarding	First	3.6 (2.7)	2.2 (2.0)	2.3 (2.1)	1.7 (1.2)	4.3(2.6)	2.7 (2.5)
	Second	2.8 (2.6)	1.9 (1.2)	2.3 (1.9)	1.6 (.67)	1.7 (.95)	3.2 (2.7)
• Societal uses	First	5.8 (1.9)	5.5 (2.5)	5.5 (2.6)	6.4 (1.7)	6.4 (2.0)	4.3 (2.1)
	Second	5.9 (1.7)	6.1 (2.0)	5.0 (2.5)	6.2 (2.2)	5.4 (2.4)	6.2 (2.0)
• Ethics	First	5.6 (2.4)	5.5 (2.7)	5.2 (2.3)	5.7 (2.5)	6.4 (2.5)	3.6 (2.3)
	Second	6.4 (2.2)	5.9 (2.7)	4.9 (2.7)	6.0 (2.4)	5.1 (2.6)	5.6 (3.0)
• Word-processing	First	3.8 (2.4)	2.7 (2.2)	1.7 (1.0)	2.0 (.9)	3.1 (2.5)	3.6 (2.3)
	Second	2.4 (1.6)	2.1 (1.7)	2.7 (2.2)	2.3 (1.1)	2.1 (1.9)	2.7 (1.9)
• Data bases	First	6.0 (2.0)	5.2 (1.8)	4.5 (1.8)	6.0 (1.9)	5.6 (2.2)	6.0 (1.6)
	Second	4.6 (2.0)	5.0 (2.2)	5.7 (2.3)	5.5 (2.1)	4.6 (2.4)	6.0 (2.5)
• Spreadsheets	First	5.6 (2.1)	5.2 (1.8)	4.6 (2.7)	5.0 (2.3)	5.2 (2.4)	6.1 (1.6)
	Second	4.4 (2.0)	5.1 (2.1)	5.0 (2.3)	5.8 (2.2)	4.8 (2.3)	5.0 (2.4)
• Curriculum software use	First	5.6 (2.2)	5.7 (2.2)	5.0 (2.3)	5.7 (1.8)	4.6 (1.8)	5.1 (2.5)
	Second	6.1 (1.6)	6.0 (1.8)	5.7 (2.5)	5.5 (1.9)	6.4 (2.4)	5.6 (2.4)
• Telecomupting	First	8.0 (2.7)	8.2 (.8)	7.7 (2.4)	8.2 (1.3)	6.8 (2.6)	8.3 (1.2)
	Second	7.9 (2.0)	8.0 (1.3)	6.4 (2.7)	7.4 (1.7)	7.0 (2.6)	7.6 (2.5)

Appendix A. Teachers' Attitude Toward Computers--Mean and Standard Deviation Scores

	Liking Computers	1994-1995 **M** (SD)	1995-1996 **M** (SD)
11.	I like using computers.	**1.63** (.94)	**1.69** (.95)
16.	I like using computers in my school work.	**1.82** (1.02)	**1.97** (1.12)
17.	I wish I could use computers more frequently at the school.	**1.82** (.94)	**1.97** (1.09)
19.	Once I start to work with the computer, I would find it hard to stop.	**2.40** (1.14)	**2.51** (1.18)
21.	If a problem is left unsolved in a computer workshop or in class, I would continue to think about it afterwards.	**2.41** (1.10)	**2.51** (1.20)
23.	Teaching using computers would be very interesting.	**2.09** (1.07)	**2.30** (1.22)
25.	I look forward to using the computers at school.	**1.90** (.97)	**1.94** (1.01)
30.	When there is a problem with a computer program I can't immediately solve, I would stick with it until I have the answer.	**2.53** (1.11)	**2.61** (1.15)
37.	I think working with computers would be both enjoyable and stimulating.	**1.88** (.91)	**2.00** (1.11)
58.	Someday I will have a computer in my home.	**1.63** (.95)	**1.84** (1.16)
28.	Working with computers is boring.	**4.25** (.91)	**4.23** (.96)
Total		**24.36**	**25.57**

	Value of Computer for Education	**M** (SD)	**M** (SD)
14.	I will use my knowledge of computers in many ways as a teacher.	**1.88** (1.03)	**1.95** (1.04)
31.	Learning about computers is a worthwhile and necessary subject for all teachers.	**1.58** (.90)	**1.57** (.86)
33.	It is important to know how to use computers in order to get any teaching position.	**2.80** (1.16)	**2.49** (1.21)
43.	Supplying every student with a microcomputer is a worthy educational objective.	**2.12** (1.12)	**2.12** (1.09)
44.	Teachers should demand that they be taught how to use microcomputers in their classrooms.	**2.09** (.95)	**2.12** (1.09)
45.	Microcomputers will require learners to become active in their learning.	**2.02** (.96)	**2.11** (.99)
48.	If we do not use microcomputers in school instruction, our students will grow up illiterate and deprived of a basic skill.	**2.60** (1.23)	**2.45** (1.21)
49.	If my school district had the money, I would insist that they buy microcomputers in most every school subject.	**2.18** (1.07)	**2.13** (1.12)
54.	Computers can improve learning of higher-order skills.	**1.95** (.89)	**2.01** (.94)

59.	Computers will improve education.	**1.70** (.90)	**1.78** (.92)
57.	Our country would be better off if there were no computers.	**4.42** (.89)	**4.40** (.93)
46.	Microcomputer instruction will deny students the opportunity to reason with others.	**3.75** (1.03)	**3.64** (1.03)
47.	Using microcomputers as a teaching tool puts too much additional work on already overburdened teachers.	**3.56** (1.16)	**3.41** (1.14)
50.	Microcomputers will increase the amount of stress and anxiety teachers experience in schools.	**3.51** (1.10)	**3.50** (1.20)
51.	Microcomputers will decrease the amount of teacher-pupil interaction in schools.	**3.71** (1.05)	**3.53** (1.11)
52.	Microcomputers will isolate students from one another.	**3.82** (.91)	**3.61** (1.04)
53.	I object to all the attention being given to computer technology because it detracts from the real problems now faced by teachers.	**3.60** (1.17)	**3.50** (1.20)
55.	Computers will displace teachers.	**4.14** (.96)	**4.20** (.93)
56.	Computers will dehumanize teaching.	**3.96** (1.00)	**4.00** (1.10)
Total		**55.39**	**54.52**

Value of Computer for Society		**M** (SD)	**M** (SD)
10.	Knowing how to use computers is a worthwhile and necessary skill.	**1.29** (.71)	**1.30** (.62)
41.	I will probably need to know how to use a computer in my classroom.	**1.63** (.93)	**1.63** (.90)
24.	I don't expect to use computers in my classroom.	**4.37** (.91)	**4.37** (.90)
42.	Computers are gaining too much control over people's lives.	**3.41** (1.20)	**3.30** (1.30)
Total		**10.7**	**10.6**

Confidence about Learning Computers		**M** (SD)	**M** (SD)
12.	I feel confident about my ability to learn about computers.	**1.78** (.96)	**1.76** (.96)
34.	I know that if I work hard to learn about computers, I can do well.	**1.60** (.71)	**1.66** (.82)
Total		**3.38**	**3.42**

	Confidence About Using Computers	M (SD)	M (SD)
27.	I feel comfortable using computers.	**2.11** (1.14)	**1.92** (1.03)
40.	I am able to do as well working with computers as most of my fellow teachers.	**1.98** (1.02)	**2.04** (1.13)
Total		**4.09**	**3.96**

	Anxiety (or Lack of it) about Computers	M (SD)	M (SD)
13.	Working with a computer would make me nervous.	**3.52** (1.31)	**3.73** (1.27)
18.	I get a sinking feeling when I think of trying to use a computer.	**4.06** (1.15)	**4.15** (1.11)
20.	Computers make me feel stupid.	**4.04** (1.15)	**4.14** 1.10
26.	I'm not the type to do well with computers.	**4.13** (1.00)	**4.10** (1.07)
32.	Computers make me feel uncomfortable.	**3.93** (1.16)	**4.05** (1.13)
36.	Computers make me feel uneasy and confused.	**3.97** (1.11)	**4.10** (1.12)
38.	I think using a computer would be difficult for me.	**4.09** (1.04)	**4.17** (1.03)
Total		**27.74**	**27.95**

	Perception about Gender-Appropriate of Computer Use	M (SD)	M (SD)
15.	Using a computer is more important for males than females.	**4.58** (.92)	**4.56** (.95)
22.	More men than women have the ability to become computer scientists.	**4.61** (.73)	**4.53** (.88)
29.	Using computers is more enjoyable for males than females.	**4.54** (.83)	**4.53** (.84)
35.	Females can do as well as males in learning about computers.	**1.47** (.93)	**1.54** (1.04)
39.	Working with computers is more for males than females.	**4.60** (.72)	**4.56** (.81)
Total		**19.80**	**19.72**

Note: For positively-worded statements 1=strongly agree and for negatively-worded statements 5=strongly disagree. Negative items are underlined

Appendix B. Means and Standard Deviations

Table 1. Descriptive statistics for teachers' attitude toward computer by six different schools in first year.

Factors measured teachers' attitude toward computers	School 1 (n=24) M (SD)	School 2 (n=24) M (SD)	School 3 (n=24) M (SD)	School 4 (n=24) M (SD)	School 5 (n=24) M (SD)	School 6 (n=24) M (SD)
1. Liking computers	**24.2** (4.8)	**25.6** (4.9)	**22.9** (5.7)	**25.6** (8.2)	**21.1** (6.5)	**24.2** (6.7)
2. Value for computer in education	**55.7** (5.1)	**55.4** (4.0)	**56.1** (3.0)	**56.5** (4.4)	**54.7** (7.4)	**54.2** (10.3)
3. Confidence for learning computers	**3.6** (1.0)	**3.2** (1.3)	**3.1** (1.1)	**3.6** (1.7)	**2.7** (1.1)	**3.1** (1.1)
4. Confidence for using	**4.1** (1.4)	**3.8** (1.7)	**3.4** (1.3)	**4.4** (2.1)	**3.8** (2.5)	**4.1** (2.1)
5. Anxiety for computers	**28.1** (4.8)	**28.5** (5.3)	**30.8** (4.3)	**26.5** (7.4)	**27.3** (7.3)	**27.6** (7.7)

Table 2. Descriptive statistics for teachers' attitude toward computer by six different schools in second year.

Factors measured teachers' attitude toward computers	School 1 (n=21) M (SD)	School 2 (n=21) M (SD)	School 3 (n=21) M (SD)	School 4 (n=21) M (SD)	School 5 (n=21) M (SD)	School 6 (n=21) M (SD)
1. Liking computers	**23.7** (5.9)	**25.8** (6.4)	**23.8** (4.7)	**23.5** (5.4)	**22.8** (4.8)	**26.3** (9.5)
2. Value for computer in education	**53.7** (4.7)	**52.5** (5.5)	**56.7** (4.3)	**54.6** (3.4)	**53.7** (11.2)	**53.4** (10.1)
3. Confidence for learning computers	**3.3** (1.5)	**3.4** (1.2)	**3.1** (1.0)	**3.0** (1.1)	**3.4** (1.5)	**3.4** (2.4)
4. Confidence for using	**3.6** (1.7)	**4.3** (1.9)	**3.6** (1.3)	**3.3** (1.2)	**3.5** (1.7)	**4.2** (2.5)
5. Anxiety for computers	**29.5** (5.9)	**27.1** (6.8)	**30.2** (4.4)	**29.3** (5.5)	**30.1** (5.3)	**27.2** (9.1)

Table 3. Descriptive statistics for teachers' attitude toward computer by previous experience in operating computers in first year.

Factors measured teachers' attitude toward computers	0 experience M (SD)	Few days M (SD)	1 to 6 months M (SD)	7 month M (SD)	Over a year M (SD)
1. Liking computers	**21.8** (5.3)	**23.6** (4.0)	**24.0** (4.6)	**27.2** (7.6)	**30.8** (6.4)
2. Value for computer in education	**54.9** (6.7)	**54.4** (4.8)	**57.0** (3.3)	**56.5** (3.9)	**57.0** (7.5)
3. Confidence for learning computers	**3.0** (1.1)	**3.6** (1.4)	**3.3** (1.3)	**3.7** (1.7)	**3.9** (1.1)
4. Confidence for using computers	**3.3** (1.6)	**3.9** (1.3)	**3.8** (1.1)	**4.7** (2.0)	**6.4** (2.0)
5. Anxiety for computers	**29.9** (5.8)	**28.3** (3.4)	**28.8** (3.8)	**25.9** (6.2)	**20.8** (7.1)

N=24

Table 4. Descriptive statistics for teachers' attitude toward computer by previous experience in operating computers in second year.

Factors measured teachers' attitude toward computers	0 experience M (SD)	Few days M (SD)	1 to 6 months M (SD)	7 month M (SD)	Over a year M (SD)
1. Liking computers	**22.8** (4.5)	**26.1** (7.3)	**29.5** (6.0)	**28.2** (8.9)	**36.7** (11.6)
2. Value for computer in education	**54.6** (6.5)	**54.5** (5.6)	**55.6** (4.4)	**48.1** (9.8)	**57.3** (13.4)
3. Confidence for learning computers	**2.9** (1.0)	**3.8** (1.4)	**4.0** (1.6)	**4.3** (2.2)	**5.7** (3.8)
4. Confidence for using computers	**3.2** (1.3)	**4.3** (1.7)	**4.9** (1.7)	**5.2** (2.2)	**8.0** (2.0)
5. Anxiety for computers	**31.0** (4.2)	**27.8** (5.9)	**23.8** (7.6)	**19.0** (6.4)	**21.7** (12.7)

N= 21

Table 5. Descriptive statistics for teachers' attitude toward computer by rate computer skills before school year in first year.

Factors measured teachers' attitude toward computers	None M (SD)	Poor M (SD)	Average M (SD)	Good M (SD)	Excellent M (SD)
1. Liking computers	**19.1** (5.4)	**19.3** (3.8)	**23.1** (5.8)	**26.7** (5.9)	**30.2** (5.8)
2. Value for computer in education	**56.2** (3.2)	**54.3** (6.7)	**55.2** (7.3)	**55.8** (4.0)	**58.0** (6.9)
3. Confidence for learning computers	**2.3** (1.0)	**2.6** (0.7)	**3.3** (1.1)	**3.8** (1.5)	**3.8** (1.3)
4. Confidence for using computers	**2.0** (0.0)	**2.6** (1.0)	**3.7** (1.2)	**5.1** (1.9)	**6.1** (2.3)
5. Anxiety for computers	**34.4** (1.3)	**31.6** (5.1)	**29.2** (4.7)	**24.9** (5.8)	**20.7** (7.4)

N= 24

Table 6. Descriptive statistics for teachers' attitude toward computer by rate computer skills before school year in second year.

Factors measured teachers' attitude toward computers	None M (SD)	Poor M (SD)	Average M (SD)	Good M (SD)	Excellent M (SD)
1. Liking computers	**19.3** (4.3)	**21.7** (4.1)	**25.5** (4.6)	**28.3** (7.5)	**33.0** (14.0)
2. Value for computer in education	**53.9** (9.3)	**53.5** (7.0)	**55.6** (5.0)	**53.4** (7.7)	**52.0** (13.2)
3. Confidence for learning computers	**2.7** (1.3)	**2.7** (0.8)	**3.2** (1.1)	**4.3** (1.7)	**5.7** (3.8)
4. Confidence for using computers	**2.9** (1.3)	**2.7** (1.0)	**3.9** (1.4)	**5.3** (1.8)	**6.3** (4.0)
5. Anxiety for computers	**33.6** (3.4)	**32.0** (3.3)	**28.7** (5.0)	**23.6** (7.0)	**16.3** (11.4)

N= 21

Table 7. Descriptive statistics for teachers' attitude toward computer by rate present ability to use computer in first year.

Factors measured teachers' attitude toward computers	None M (SD)	Poor M (SD)	Average M (SD)	Good M (SD)	Excellent M (SD)
1. Liking computers	**17.9** (3.3)	**21.5** (4.6)	**26.6** (5.7)	**30.4** (6.3)	**22.0** (2.8)
2. Value for computer in education	**53.9** (7.4)	**55.5** (4.5)	**55.8** (7.2)	**56.3** (5.4)	**54.5** (3.5)
3. Confidence for learning computers	**2.2** (0.4)	**2.8** (0.9)	**3.6** (1.1)	**4.5** (1.5)	**2.0** (0.0)
4. Confidence for using computers	**2.2** (0.6)	**3.0** (1.1)	**4.4** (1.4)	**6.6** (1.9)	**2.5** (0.7)
5. Anxiety for computers	**32.8** (4.9)	**30.9** (4.3)	**27.0** (4.6)	**19.8** (6.6)	**34.5** (.7)

N=24

Table 8. Descriptive statistics for teachers' attitude toward computer by rate present ability to use computer in second year.

Factors measured teachers' attitude toward computers	None M (SD)	Poor M (SD)	Average M (SD)	Good M (SD)	Excellent M (SD)
1. Liking computers	**20.1** (3.8)	**23.0** (4.6)	**27.7** (6.0)	**30.3** (6.9)	**49.0** (0.0)
2. Value for computer in education	**52.7** (9.8)	**55.0** (5.0)	**54.1** (7.1)	**51.2** (7.7)	**67.0** (0.0)
3. Confidence for learning computers	**2.5** (1.0)	**2.8** (1.0)	**4.1** (1.5)	**4.2** (1.6)	**10.0** (0.0)
4. Confidence for using computers	**2.6** (1.1)	**3.2** (1.2)	**4.7** (1.6)	**6.5** (2.1)	**10.0** (0.0)
5. Anxiety for computers	**33.0** (3.2)	**31.1** (4.1)	**25.1** (5.7)	**19.5** (8.6)	**7.0** (0.0)

N=21

Table 9. Descriptive statistics for teachers' attitude toward computer by those who are currently using computers and those who are not currently using computers by year.

Factors measured teachers' attitude toward computers	Using computers		Not Using computers	
	94-95 M (SD)	95-96 M (SD)	94-95 M (SD)	95-96 M (SD)
1. Liking computers	23.1 (5.7)	23.8 (6.1)	28.2 (8.1)	27.9 (6.0)
2. Value for computer in education	54.9 (6.1)	54.0 (7.1)	59.0 (5.3)	55.5 (5.8)
3. Confidence for learning computers	3.3 (1.2)	3.2 (1.5)	3.4 (1.7)	3.9 (1.1)
4. Confidence for using computers	3.8 (1.8)	3.6 (1.7)	4.4 (2.1)	4.9 (1.9)
5. Anxiety for computers	28.4 (6.1)	29.6 (5.8)	26.6 (7.8)	24.7 (7.8)

1994-1995 (first year) N= 24
1995-1996 (second year) N= 21

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