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Uses of Technology by Science Education Professors: Comparisons With Teachers' Uses and the Current Versus Desired Technology Knowledge Gap

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Abstract

A survey of the AETS membership was conducted to examine potential gaps in their current versus desired knowledge about technology uses relative to science teacher education.

Technology is a queer thing. It brings you great gifts with one hand, and it stabs you in the back with the other.
(C.P. Snow, as quoted by Lewis, 1971, p. 37)

Perhaps one of the more tangible recent changes in schools is the presence of technology. Admittedly, standards-based reform policy, pressures for greater accountability, and the concomitant explosion of test administration frequency are changes one can also discern. But in terms of physical presence, technology and especially computers represent an obvious change in the complexion of schools. One has only to venture into the media center of any school to see the absence of the polished wooden card catalogs that have been replaced by monitors and keyboards guiding students to the resources they are seeking. Within most classrooms, as well, technology has taken center stage. Multimedia projectors, computers, probes, and other technological devices have begun to permeate science classrooms.

Given the unmistakable presence of technology, one cannot help but wonder how these devices have influenced educational practices. After all, many of the technologies currently in use in schools are business devices that have been appropriated for purposes of schooling. Although questions about the appropriateness of business tools as educational devices should be left for others to explore (Stroup, 2003), there are some immediate questions relative to science teacher education and technology that need to be addressed.

Examining technology use from the vantage point of policy makers can be revealing. In their analysis of the technology plans of 15 states, Yong Zhao and Paul Conway (2001) reported several troubling aspects of technology implementation. These included a propensity to favor innovative technologies over more established media, an assumption that reform was an inevitably accompanied technology implementation, and the premium upon improved student test scores with substantially less attention given to improving teaching for understanding. Our perspective is much less ambitious — we prefer to consider technology for its p otential but acknowledge the dangers of taking computers as an educational panacea. Our hopefulness is tempered by an awareness of the difficulties of effecting lasting change.

This article makes use of published reports of teachers' technology uses, as well as data collected from members of the science teacher education community in an effort to examine several questions. Given the ever-changing nature of technology and the world of education, the findings represent a snapshot at a particular point in time that will surely evolve over the coming years. Thus, this study provides a benchmark against which future studies can be compared. The current study is an extension of a previous investigation and represents another step in a continuing line of inquiry regarding technology and technology usage in the preparation of teachers of science (Pedersen & Yerrick, 2000).

Background

Technology in classrooms, whether preparing science teachers or teaching K-12 students science, has undergone tremendous evolution over the past few decades. To a large part this is due to the very nature of the types of technology available to educators at all levels. The recommendation of technology usage for teaching science is reflected in the *National Educational Technology Standards* (International Society for Technology in Education [ISTE], 2000) and the National Science Teachers Association's (NSTA, 2003) *Standards for Science Teacher Preparation*.

The NETS recommend that teacher candidates continually observe and participate in the effective modeling of technology use for both their own learning and the teaching of their students. Stressing that technology must become an integral part of the teaching and learning process in every setting supporting the preparation of teachers, NSTA (2003) noted that general teaching skills should include the successful use of technological tools, including but not limited to computer technology, to access resources, collect and process data, and facilitate the learning of science.

As a further indication of the growth of technology, the National Education Association (NEA) compiled benchmarks for distance education (course development and structure, institutional support, teaching/learning processes, student support, and assessment) and then evaluated these benchmarks in the context of several institutions (Phipps &

Merisotis, 2000). The result has been a refined set of benchmarks for distance education that accurately reflect best practices in using the Internet as a course delivery mechanism.

Along these same lines, the American Federation of Teachers (AFT, 2000) developed guidelines for distance education based upon surveys of 200 AFT members from higher education institutions. Many of their guidelines are consistent with the standards presented in the NEA report. However, the AFT report was much less subtle in its support for distance education: “The practitioners responding to our survey overwhelmingly indicated that we should move forward with distance education” (p. 6).

There is obvious support for technology at many levels as organizations such as ISTE, NSTA, NEA, and AFT advocate for technology in day-to-day instruction. Given this increased emphasis on technology use, researchers are also responding by examining various technologies and the use of technology in classrooms. Researchers have examined multimedia CD-ROMs, teaching methods, and student learning processes vis-à-vis technology development (Halyard & Pridmore, 2000) and how technology is transforming science education across America (Devitt, 1997). The U.S. Department of Education (Smerdon et al., 2000) examined how students used computers in classrooms. The report indicated that 61% of teachers (K-12) have students use computers for word processing and spreadsheet work, while 51% reported that students conduct research using the Internet. The study also examined where in the school they can access the Internet. Ninety percent of teachers indicated that access is available somewhere in the school, with 64% reporting it is available in their classrooms. Of those classrooms with Internet access, most commonly (46%) this access was via a single computer, with only 4% of classrooms having more than five computers with Internet access.

Beyond the realm of science in the K-12 classroom, researchers have also investigated the impact of technology on the preparation of science teachers, including science educators becoming familiar with electronic resources (Didion, 1997) and the use and current knowledge of technology in science educators (Pedersen & Yerrick, 2000; Odom, Settlage, & Pedersen, 2002). There are literally hundreds of studies examining the impact of technology usage on both preservice/in-service teacher preparation and K-12 students.

Researchers have examined higher education faculty members' access and usage of technology. In a study on the use of telecommunications technology by postsecondary institutions (Warburton, Chen, & Bradburn, 2002): 96.7% of higher education faculty members report having access to the Internet. Email communication between full-time students and their professors is the highest among education faculty, with 45.9% of students reporting that they used email to communicate regarding course material (engineering/computer sciences students: 44%, natural/physical science and math: 27.5%). Faculty members who reported communicating with students or using course-specific websites represented 69.2% and 40.4% of respondents, respectively.

The adage “we teach as we are taught” can be aptly applied to technology in science education. The vast majority of future teachers receive their credentials through colleges or departments of education, oftentimes including a course in methods of teaching science. Although it would be a gross oversimplification to suggest that technology use in methods classes will invariably translate into uses in the preservice teachers’ future classrooms, one would reasonably expect some correlation. If technology is integrated into a science methods course, then it seems more likely that the next generation of teachers will incorporate technology into their science teaching. Likewise, only the most ambitious students would implement technology in their science teaching if they had no exposure to it in their methods courses. For this reason this study examined the overlaps and disparities in technology expertise and use for precollege teachers and education professors.

Uncertainties remain regarding technology use in science education—specifically, who uses technology in their classrooms and for what purpose; how familiar are educators with the technologies they are using; and how much do educators know about the technology tools that they are using? Favorable advocacy is often *parti pris* of studies on educational technology. Within this study we endeavored to distance ourselves from this tendency, preferring to characterize ourselves as capable users but skeptical advocates of computers within the context of science teaching and learning.

Purpose

Information is available about uses of technology in public schools and in our colleges and universities. Less clear, however, is the situation within science education, and this is significant because science teachers have potentially more technology tools at their disposal than do any other academic areas. Although the Internet, electronic databases, and CD-ROMs might be used in social studies as much as in science, because of the experimental and analytical features of science (e.g., probes and modeling software) the value of preparing teachers to find appropriate uses for technology is quite high for science educators. The purpose of this study was to establish the technology knowledge and use, as well as relative levels of desired technological knowledge among members of Association for the Education of Teachers in Science (AETS) as compared to K-12 science teachers.

Three issues guided the collection and analysis of data. One issue of interest was the similarity in technology uses at the precollege level versus expressed knowledge about the same technologies at the postsecondary level. The data gathered within the present study were compared to data gathered for similar purposes about public school teachers. A second area of interest was the familiarity science educators have with different types of technology. Science educators may be using technology as instructional tools, for supporting their productivity, and for conducting research. Survey items gathered data that clearly identified the respondents' current levels of knowledge of a wide variety of educational technologies.

The final question emerged from an organization-wide uncertainty about appropriate forms of ongoing professional development. In other words, the survey was viewed as a mechanism for discerning the technological know-how needs of the AETS membership. This was accomplished by asking respondents to indicate their desired levels of knowledge for various technological tools. In doing this we were able to compare current with desired knowledge to discover the largest gaps. Together these three research questions seemed likely to provide us with a clear sense of the current state of technology knowledge, both current and desired, within the science education community.

Methodology and Instrumentation

The methodology was based upon a previous survey of the AETS members (Pedersen & Yerrick, 2000) with one major departure. We used a web-based survey site and an email merge to invite members to participate in the study. The survey examined the differences between current and desired levels of knowledge about using technology as an instructional tool, to support research, to enhance productivity in classroom applications, and to enhance data collection and analysis.

The instrument was a web-based questionnaire. The questionnaire had two general sections, technology usage and needs and demographics. The technology usage and needs section contained seven subsections:

1. Using technology as an instructional tool.
2. Using technology to support educational research.
3. Using technology to enhance productivity.
4. The effects of computers in the classroom.
5. Computer usage in science.
6. How to use the Internet to teach science.
7. How to use other technologies in the classroom.

Demographic data was collected with 19 items, which included

1. Highest degree earned.
2-4. Degree areas.
5. Teaching levels.
6. Certification areas.
7. K-12 teaching experience.
8. Availability of a media center at one's institution.
9. Teaching responsibilities.
10. College/university rank.
11. Conference attendance.
12. Current publications.
13. Internet training.
14. Location of Internet training.
15. Location of Internet use.
16. Creation and/or maintenance a science or science education website.
17. Last year completing a science course.
18. Last year completing an education course.
19. Name, address, and institution. (Appendix A)

The questionnaire was written as a form and placed on a website using Microsoft's FrontPage. A form is a collection of fields that can be use for gathering information from people visiting a web site. The data in this study was submitted directly to an Excel spreadsheet (see Appendix B for technical procedures). A backup copy of each response was automatically emailed to a different site. An email merge of AETS members was used to solicit participation in the survey. The email message included the survey website address, how the information would be used, and a confidentiality statement. A record of invalid email addresses and responses was kept, and those addresses were deleted from the master email list. A follow-up email request to participate in the survey was sent 1 month later using the updated list. For each survey item, respondents were to give an indication of their present level (current) and hoped for (desired) level of technology knowledge using a 5-point Likert scale. A value of 1 represented a very low level of knowledge, while 5 represented a very high level of knowledge. The data reported here represent the contributions of 274 individuals.

For each prompt, respondents were to give an indication of their present level (current) and hoped for (desired) level of technology knowledge using a 5-point scale. A v alue of 1 represented a very low level of knowledge, while 5 represented a very high level of knowledge. This pattern of current and desired knowledge was used for each item. Items were categorized into subsections and Cronbach alpha was used to estimate t he internal consistency of the instrument (Ferguson & Takane, 1989). The range of values for the subsections was 0.77-0.94. The overall value was 0.97 (Table 1).

Table 1
Major Categories of Survey and Distribution of Items

Category	No. of Items	Cronbach Alpha
As an instructional tool within your teaching	10	0.88
To support educational research efforts	4	0.77
For enhancing productivity	6	0.84
Effects of computer use on ...	4	0.90
How to use a computer in science for ...	8	0.94
How to use the Internet to ...	10	0.92
How to use other technology in the classroom	16	0.94
Overall		0.97

Findings

In the following three subsections, we address the corresponding research questions are addressed. For the first question we took advantage of published data on technology uses by classroom teachers and compared that data to the information collected for this study.

Comparison of Teachers and Professors

Teachers were asked to indicate the frequency with which they used computers or the Internet to assist them in accomplishing certain goals: maintaining student records, making class presentations, and so on (Lanahan, 2002). Professors were asked similar questions, although the differences in the uses of technology represent the differences between the work of teacher versus professors: Professors were not asked about their use of technology to gather lesson plan information (Figure 1).

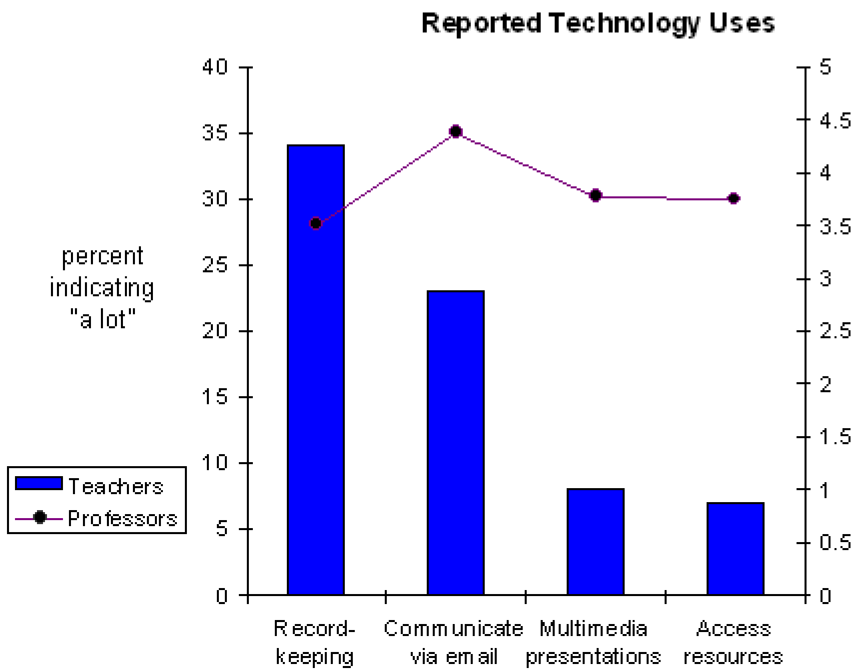

Figure 1. *Comparisons of technology uses as reported by teachers (reported as % who said "a lot") and professors (rated on a scale of 1 to 5).*

Having gathered the data from the two groups using different techniques, the most accurate way to compare the two is to examine the relative weights. The use of technology that was most heavily weighted for teachers was record keeping followed by communication with email. In contrast, communicating with email was the technology use for which professors reported having the strongest knowledge, with multimedia presentations and access resources (e.g., research databases) having greater weight than record keeping. One explanation for teachers' technological premium on record keeping could be the escalating importance of tracking individual student progress (the "accountability pressures" may not be as new to the profession as we might believe; see Lortie, 1975). Another reasonable explanation for the differences relates back to Internet access. If teachers had easier access to the Internet, especially from their classrooms, perhaps email would be used much more. Or the differences may simply be reflective of the demands and responsibilities that distinguish teaching from professoring; for the former the workday is fairly tightly scheduled, while the college professor may teach as many hours in a week as a teacher does in a day. As a consequence, their needs for technology differ.

By comparing teachers and professors in their uses of technology we found some differences. This may be explained by the distinctive job responsibilities. There are also differences in work environments (e.g., Internet access) that might translate into the varied uses of technology. In the following section the uses of technology by science education professors are explored in greater detail.

Professors and Their Familiarity With Technology

Respondents were asked to rate their current knowledge level relative to varied types and uses of technology, indicating their selection on a scale of 1 to 5 (low to high). Across all survey items, the technology with the highest current knowledge was the use of overhead transparencies (mean = 4.61) with the lowest rating being assigned to MP3 players (mean = 1.88). The modal rating was 2.79 (hypermedia and desktop publishing), and the median response was 3.14 (between posting readings electronically and demonstrating commercial instructional software). This distribution suggests that the items included in the survey were appropriate, as the respondents did not have excessively high nor exceedingly low knowledge. Technology uses with the highest current knowledge levels are presented in Table 2.

Table 2
Technology Uses for Which Respondents Had Current Knowledge Levels With Modal Responses of 4 or 5

Technology Use	Mean	Mode
Communicate via email	4.41	5
Co-author manuscripts using email attachments	3.72	5
Word processing	4.29	4
Searching information on Internet	4.04	4
Read and/or retrieve online articles, books, manuscripts	3.80	4
Making presentations (e.g., via PowerPoint)	3.77	4
Accessing online indexes (e.g., ERIC, Educational Abstracts)	3.75	4
Using spreadsheets to maintain records and grades	3.66	4

Except for the use of spreadsheets, all the uses of technology In Table 2 are text based. Given the nature of the work of the typical academician (writing, reviewing, reading, editing) these uses of technology seem reasonable. However, they do not represent dramatically different uses of technology; one issue that has been raised about educational technology is that it has made little impact upon the work of teachers—essentially they go about their work, and presumably how they think about their work, in ways that are parallel to teachers' work and thinking for decades (Cuban, Kirkpatrick, & Peck, 2001). Without wishing to criticize our science education colleagues, this list suggests parallels with the lack of change in the precollege classroom; except for being paperless and faster (perhaps) the knowledge levels are probably quite similar to science education professors of 20, 30, or 40 years ago (Table 3).

Table 3
Technology Uses for Which Respondents Had Very Low Current Knowledge (Modal Responses of 1)

Technology Use	Mean	Mode
Electronic white boards	2.47	1
Personal Digital Assistants (e.g., PalmPilots)	2.39	1
Global Positioning System (GPS)	2.11	1
Editing video	2.08	1
Working with qualitative data (e.g., HyperQual, NUDIST)	2.00	1
Geographical Information Systems (GIS)	1.90	1
MP3 Players	1.88	1

The implications of this research would clearly indicate areas in which educators have low current knowledge and could assist us in making decisions regarding areas to begin focusing professional development (Table 3). It should be kept in mind, from the perspective of the authors, that technology for the sake of technology use is not what is being suggested. Rather, the use of technology should be as a tool to assist the learner in understanding concepts. Any technology can be misused or abused. As such, all technology can be useful in the appropriate context. It is not our position to decide whether or not a particular technology is useful or a particular technological skill is useful, rather to provide the data for educators to develop a better understanding of the knowledge levels for various technologies. It is not technology for technology's sake. It is to be a tool that assists the learner in a deeper or more efficient learning experience, and the simplest and most effective technology tool should be used.

The Differences Between Current and Desired Technology Knowledge

In a manner consistent with Pedersen and Yerrick's (2000) study of technology use, the present study asked respondents to indicate both their current levels of knowledge and their desired knowledge levels for each of several dozen types of technology. Generally the higher mean levels of current knowledge were accompanied by higher means for desired knowledge, to the tune of a statistically significant correlation of +0.688 ($df = 44$), With an eye toward identifying departures from this relationship, we have selected a few technologies where the difference between current and desired knowledge is exceptional.

There were five technologies for which the modal response for current knowledge was 1, while the modal response for desired knowledge was 5—indicative of the largest gap (see Table 4). These technological knowledge gaps were, in descending order, working with qualitative data, geographical information systems, global positioning systems, electronic white boards, and personal digital assistants. The average gap between current and desired knowledge level means for these five technologies was 1.64. Clearly if one was interested in supporting science educators and their facility with using technology, these five areas would be wise areas within which to begin.

Table 4
Technology Uses Where Differences Between Current and Desired Levels of Knowledge Were Among the Largest

Technology Use	Current Mean	Current Mode	Desired Mean	Desired Mode	Difference Between Means
Working with qualitative data (e.g., HyperQual, NUDIST)	2.00	1	3.90	5	1.90
Geographical Information Systems (GIS)	1.90	1	3.62	5	1.72
Global Positioning System (GPS)	2.11	1	3.76	5	1.65
Editing video	2.08	1	3.59	3	1.51
Electronic white boards	2.47	1	3.95	5	1.48
Personal Digital Assistants (e.g., PalmPilots)	2.39	1	3.86	5	1.47

With the exception of qualitative data analyses, most of these technologies lack an obvious connection to the types of computers with which science educators are familiar (the exception could be video editing, which is commonly done digitally). Perhaps the gaps science educators revealed between their current and desired knowledge reflect a basic lack of awareness of these technological tools. Underneath the uncertainty is an interest in learning more, as reflected in their responses in the desired knowledge fields.

In contrast, there were several technologies where current and desired levels of knowledge were almost the same. For the items about co-authoring manuscripts using email attachments and communicating via email, the modal response for both current and desired knowledge was 5. Additionally, six technologies revealed a modal current knowledge level of 4 with a desired knowledge level of 5 (see Table 5). Notably, the mean desired level of knowledge for word processing was actually lower than the mean current level of knowledge. This suggests that science educators' knowledge about word processing is excessive; one implication is that more knowledge (and energy) has been devoted to formatting documents than the respondents feel is actually useful or necessary.

Table 5
Technology Uses Where Differences Between Current and Desired Levels of Knowledge Were Among the Smallest

Technology Use	Current Mean	Current Mode	Desired Mean	Desired Mode	Difference Between Means
Read, retrieve online articles, books	3.80	4	4.49	5	0.69
Making presentations (PowerPoint)	3.77	4	4.44	5	0.67
Accessing online indexes	3.75	4	4.41	5	0.66
Co-author using email attachments	3.72	5	4.33	5	0.61
Using spreadsheets to maintain records	3.66	4	4.19	5	0.53
Searching Internet	4.04	4	4.56	5	0.52
Communicate via email	4.41	5	4.57	5	0.16
Word processing	4.29	4	3.70	5	-0.59

Discussion

The sense of preparedness expressed by teachers for using technology is strongly related to the amount of professional development they receive (Smerdon et al., 2000). As teachers receive more hours of in-service training about using computers and the Internet for instructional purposes, the number who feel well to very well prepared increases proportionately. For those who advocate for technology as a powerful tool within the larger science education milieu it is apparent that teacher confidence is responsive to professional development.

By considering the data gathered by the U.S. Department of Education, we were able to compare teachers' uses of technology with the knowledge reported by science educators. As one would expect, even though both groups fall within the general category of "educators" their work is far from identical. The predominant use of technology by teachers is for the purposes of record keeping, while the professors in the current study do less "bookkeeping" with their technology but instead are more knowledgeable about technology for communicating via email, accessing databases, and making multimedia presentations. One possible expectation is that teachers' uses of technology may shift to make greater use of more innovative technologies, including telecommunications.

The second goal of this study was to establish the current levels of knowledge that the participants had about various technologies. Science educators seemed especially knowledgeable about such computer-based technologies as those involving email, word processing, and seeking information. For several technologies, science educators reported very low current levels of knowledge. Several of these technologies have less obvious connections to the typical desktop computer (e.g., geographic information systems, global positioning satellites, and electronic whiteboards), although familiarity with using computers to conduct qualitative analyses of data was also an area in which current knowledge was reportedly low.

Third, the data gathered for this study revealed that professors recognize the variety of educational technologies that exist and have the desire to learn more about some than others. By comparing current with desired knowledge levels we were able to identify technology uses for which professional development would seem most advisable. The participants were not equivalently interested in all things shiny, electronic, and new but revealed greatest interest through the size of the current-to-desired knowledge gap in working with qualitative data, making use of satellite-based tools (i.e., GPS and GIS), and editing video footage.

What is required in order for educational technology to take root in science classrooms? In their study of technology implementation, Zhao, Pugh, Sheldon and Byers (2002) emphasized that to concentrate upon the technology itself is unwise. They identified the salient roles played by the context of the school, the nature of the innovation, and the teachers themselves. Not surprisingly, Zhao et al. (2002) identified the teacher as the most significant factor in the success of a technology's implementation. As efforts are expended to deepen the sophistication with which science educators utilize technology, this attention to the user must be heeded. Only by making the human element front and center of any technology innovation can we hope that the electronic tools will prove beneficial rather than cause the sorts of damage against which C. P. Snow has cautioned us.

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Appendix A

ASSOCIATION FOR THE EDUCATION OF TEACHERS IN SCIENCE
MEMBERS SURVEY OF TECHNOLOGY USAGE AND NEEDS

Directions: Each statement should be rated in two different ways using two sets of numbers. The first set of numbers describes your present level of knowledge with respect to the statement. The second set of numbers describes the desired level or knowledge you would like to have. (If you have as much knowledge as you would like to have, the same number should be circled in each column.)

Scale: 1 Very Low 2 Low 3 Moderate 4 High 5 Very High

I. As an Instructional Tool within Your Teaching:

a. word processing.
b. spreadsheet application.
c. database application.
d. desktop publishing.
e. making presentations (e.g., via PowerPoint).
f. teach students at a distance.
g. telecommunications (i.e., email).
h. using spreadsheets to maintain records and grades.
i. demonstrating, using commercial instructional software.
j. deliver individual learning (computer aided learning).

II. To Support Educational Research Efforts:

a. editing video.
b. statistical analyses (e.g., SPSS, SAS, Excel). c. working with qualitative data (e.g., HyperQual, NUDIST).
d. accessing on-line indexes (e.g., ERIC, Educational Abstracts).

III. For Enhancing Productivity:

a. word processing.
b. creating graphs and other visual displays of data.
c. time management and personal scheduling.
d. publishing (newsletters, CDs, PDF files).
g. design of instructional materials.
f. aid in class management (i.e., monitor attendance, track grades).

IV. Effects of computer use on:

a. classroom management.
b. class preparation.
c. class presentations.
d. professional presentations.

V. How to use a computer in science for:

a. collecting data using peripherals.
b. database storage of lab data.
c. graphing.
d. demonstrations and modeling.
e. interfacing.
f. problem solving.
g. science/technology/society issues.
h. spreadsheet for analysis of lab data.

VI. How to use the internet to:

a. communicate via email.
b. web-based instruction (e.g., WebCT or Blackboard.com).
c. post readings electronically.
d. co-author manuscripts using email attachments.
e. create dialogue among students through list serves, electronic bulletin boards, threaded discussions, chat rooms.
f. make use of a customized course website.
g. exchange ideas and/or data with students at other sites.
h. access the Internet for lesson planning resources.
i. read and/or retrieve on-line articles, books, manuscripts.
j. search for information on the Internet.
k. What are other things you would like to learn about the Internet? Write-in below.

VII. How to use a disk operating system.

VIII. How to write an original computer program.

IX. <u>How to use other technology in the classroom</u>:

a. video.
b. film.
c. interactive video.
d. hypermedia.
e. overhead transparencies.
f. slides.
g. concrete manipulatives (models).
h. calculators.
i. microscopes.
j. digital camera (still/video).
k. science kits.
l. personal digital assistants (e.g., PalmPilots).
m. electronic white boards.
n. global positioning system (GPS).
o. MP3 players.
p. geographical information systems(GIS) .

X. What topics would be of most interest to you during an AETS Pre-conference workshop on technology in science teacher education?

XI. Demographics

1. Highest Degree Earned
2. Write-in undergraduate degree area.
3. Write-in masters degree area (if applicable).
4. Write-in doctoral degree area (if applicable).
5. Level(s) you are currently teaching.
6. Certification area.
7. Primary grade level you taught when in public or private k-12 school.
8. Does you institution have a media center?
9. Major teaching responsibilities. Write in boxes below.
10. Current rank. Specify other.

11a. What year did you last attend a national science education convention?

11b. Please indicate the conventions you attend most often.

12. Have you presented a paper, workshop, or other scholarly work at a national science education conference?
13. Have you written a journal article in the past two years?
14. Where did you receive most of your internet training?
15. Where do you use the internet most often?
16. Do you have or maintain a website related to science or science education?

16a. If yes, indicate your URL.

17. What was the last year you completed a science course?
18. What was the last year you complete

Appendix B

THE BASICS OF CREATING AN ONLINE SURVEY FORM

The questionnaire was written as a form and placed on the web using Microsoft's FrontPage. A form is a collection of fields that can be used for gathering information from people visiting a Web site. Site visitors fill out the form by typing text, clicking radio buttons and check boxes, and selecting options from drop-down menus.

A **one-line text box** is used to accept one line of information from a site visitor. **Radio buttons are used** when you want a site visitor to select one option in a group on your form. Only one radio button in a group can be selected at a time. **Check boxes** are used when you want a site visitor to select one or more items, or none at all. **Drop-down menus** allow the site visitor to choose options from a list or menu. You can set the properties of the menu so that only one choice can be made, or you can allow multiple choices. **A reset push button** is used to allow a site visitor to reset the form to its default settings. Clicking the reset button deletes any text that has been entered in a field and clears any selections that have been made.

Each form field (radio button, etc.) is assigned an **internal name** to specify the choices that you want displayed on the menu. An internal name is not displayed on the form, but identifies the field in the form results. A **submit push button** allows the site visitor to submit a form after filling it out. When a form is submitted, the data is sent to the form handler, including the internal name of the submit button and its value/label. An internal name is not displayed on the button, but identifies the field in the form results.

A **confirmation page** can be used to display the contents of form fields after the survey is complete. The site visitor can confirm that the information was entered correctly and, if necessary, return to the form and fill it out again. You can also personalize the confirmation page; for example, if you request the site visitor's name in your form, you can display it on the confirmation page. You can also thank the site visitor for participating in the survey.

You can send form results (data that a site visitor enters in your form) in an **email message**. Each time a site visitor submits a form, a message containing the results of the form is sent to the email address you specify. You can also configure other options for the messages, such as the text for the Subject line and the address for the Form (Reply To) line.

After filling out the form, site visitors submit the data they entered, which can be processed in a variety of ways. The data in this study was submitted directly to an Excel Spreadsheet. Previously defined **internal names** served as column headings.

Once the survey has been written and placed on the web, it must be tested from several remote sites before proceeding. Colleagues on and off campus with a variety on browsers (i.e., Netscape, Internet Explorer) and computer types (i.e., PC, Mac) should participate in the test. All data entry combinations should be tested. For example, if the survey contains radio buttons, each should be selected and submitted. This will help identify potential form construction errors. You may find that older computers and web browser software will not be able to access the website or read all of its components. This will be a problem among respondents with older computers/software.

Once the revisions are complete, erase the test data collected in the spreadsheet. Perform several additional tests to determine if the form is working properly. Code the data to indicate a test. If you have one-line text boxes, write-in "test." After the final tests are complete, do not change any part of the survey form or spreadsheet. It is easy to damage the survey, making it impossible to collect data. Test data can be deleted after the survey is complete. A back-up copy of each response can and should be automatically emailed to a different site. Hard copies should be made of each email response.

Electronic requests to participate in the survey can be made on a listserv or by a personal email request. One participant indicated she quickly browsed over a listserv request to participate in a survey but felt compelled to participate only after receiving a personal request to participate.

You can use an email merge to create a personal request to participate in the survey. This allows you to send a generic document to a large number of people without typing a personal email to each. The email merge works the same as a letter mail merge. The mailing list can be placed on an excel spreadsheet or access database. It should include a minimum of the salutation, last name, and email address.

Merge fields are placed in the letter for sorting into personalize requests. Additional information, such as, first name, institution, address, email address, etc. can help identify survey participants. This information should also be placed on the survey form to help ID participants.

The email message should include the survey website address, how the information will be used, and a confidentiality statement. For the AETS survey, a record of invalid email addresses and responses was kept and those addresses were deleted from the master email list. Two additional follow-up email requests were made over one month later using the updated list.

Be prepared to manage returned invalid email after the email merge. It is easy to overwhelm your email account when you receive a large number of returns in a short period of time. Hard copies of each return can be made and cross-referenced with the master email list.