A Comparison of Teacher Education Faculty and Preservice Teacher Technology Competence

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Abstract

Technology skills and attitudes were compared between 51 school of education faculty members and 378 student teachers in teacher education programs in six Northwest liberal arts colleges. Few significant differences were found between the groups. In general, faculty members had higher levels of knowledge of a greater number of technology-based tools but students reported higher levels of skill with on-line communication tools and graphing calculators. Evidence did not appear that suggests student teachers believe themselves to be more technology competent or know more about educational technology than school of education faculty members.

It is widely held, although not well substantiated, that college students are more comfortable with and proficient using technology than their instructors. This study examines the differences in knowledge and use of technology between preservice teachers and teacher education faculty. Dickson (2000) is typical of this point of view. "Students generally know more about how to set up and use information technology than their teachers, and they instinctively realize that information technology plays a different role in their lives. …As teachers we tend not to have the same fluency in the use of information technology as our students" (p. 39). Fisher (2000) goes on to say, "…educators must consider the predictions and innovations that our youth are exploring and examining as potential resources" (p. 112).

In a longitudinal study, Sheffield (1998) reports a linear pattern of increases in entering teacher education students' facility with word processing, spreadsheets, hardware, operating systems, and the mouse. Even at the middle school level, teachers report that students often know more than they do about using technology (Dooling, 2000). Although, Dooling found that these differences in knowledge tend to be software specific.

Some studies of college faculty technology skills reflect a potential for problems to appear. Odom, Settlage, and Pedersen (2002), for instance, found that although science educators wanted to know more about uses of technology in instruction, few had any training in the area. Brown (2001) found faculty having high competencies with word processing, e-mail and browsers but with very little else. Numerous studies have identified reasons that inhibit faculty use of technology. Mumtaz (2000) summarizes them as *institution* (lack of time and a community of support), *resources*, and *the teacher* (teacher beliefs about the value and appropriate use of technology). Interestingly, Spotts (1995) discovered that regardless of skill level faculty did not identify changes in student technology skill as an influence on their own use. Also potentially problematic is that difficulties related to infrastructure may be an inhibitor to the use of technology for faculty but not necessarily for students. Persichitte, Tharp and Caffarella (1999) found that student technology use is proportionally higher than faculty use at institutions without adequate infrastucture.

Another widely held belief, but one more clearly demonstrated in research, is that teachers teach the way they were taught (Judson & Swanda, 2001; Lortie, 1975). This is reappearing in the literature related to education technology in a number of studies (Fisher, 2000; Kemp, 2000; Matthew, Callaway, Letendre, Kimbell-Lopez & Stephens, 2002). If both of these premises are true—students know more than faculty about technology and teachers teach as they were taught—then it seems likely that preservice teacher programs will be hard pressed to provide instruction that will effectively model appropriate uses of technology in classrooms (classrooms that are likely to be equipped with technologies with which teacher education faculty are less familiar than their students).

Other evidence presents a different picture. Parrish, Vrbsky, Cordes, and Fortner (1995) found that college students demonstrate weaker knowledge in some information technology areas even after a broad-based course on the subject. While Scheffield (1998) reported steady increases in computer literacy of entering college students, he also found these students have little of the skills necessary for an introductory educational technology course. More directly, Spotts and Bowman (1995) found faculty have higher knowledge levels than their students about some technologies, particularly those they used in instruction. High and Marcellino (1997) reported that college mathematics education faculty had more knowledge than high school mathematics teachers did about discipline-specific technology uses, and they talked to their students about it more frequently. Hocutt, Standford, Wright and Raines (2002) found that high school students identified teachers as their primary source of knowledge and skill in technology. On the surface, these studies seem to be in conflict with those that identify students as possessing stronger technology skills than their faculty.

Clearly there is a baseline of technology integration with which the vast majority of our citizens must deal—telephones and video players, UPC scanners and computerized automobile accessories, bank transactions and on-line merchandise ordering to name a few. Each year this baseline changes, and it usually adds a considerable number of technology-based skills with which each of us must be familiar. Whether a baseline of technology use exists in educational settings is more problematic. It may be that faculty and students are uniformly increasing the technology skills they bring to colleges and universities, or it may be that gaps are appearing between the level of technology competence of these two groups.

The study of this issue is exacerbated by the fact that technology skills in academe are dependent on the academic subject under investigation (Cuckle, Clarke & Jenkins, 2000). While there are common uses of technology like e-mail and word processing common to every discipline, each content area has specific tools and ways of using those tools that are unique. It would be expected that faculty and students in history or computer science would use different tools and have different skills than faculty and students in English or physics, for example.

Purpose

Given the current research base, the approach used in this study is to focus solely on one content area—teacher preparation—and investigate a wide range of technologies, including both general use and discipline specific, and to compare the familiarity with these technologies of teacher education faculty and students. The purpose of this study is to identify differences in knowledge and use of technology between preservice teachers and teacher education faculty, specifically their self-perception of:

1. Technology competence
2. Skill level with specific electronic technologies
3. Technology use based on National Educational Technology Standards.

Methods

Participants for this study included the teacher education faculty members and student teachers from six small, private liberal arts colleges in Oregon. The Schools of Education of these schools were part of a collaborative Preparing Tomorrow's Teachers to Use Technology federal grant. All of the schools have similar education programs guided by Oregon Teacher Education Standards and maintain similar entrance requirements for students into the programs. All but one of the schools require successful completion of all state-mandated testing requirements for initial licensure prior to admission into Master of Arts in Teaching (MAT) programs. The student teachers in four of the schools represent both Bachelor of Arts and MAT programs. The remaining two schools only offer MAT programs for preservice teachers. These schools of education graduate approximately 40% of the new teachers in Oregon each year, and because of the extensive state-level requirements for teacher education programs, they are representative of other programs in the state.

Gathering data about uses of technology has been problematic (Ross & Morrison, 1996). The difficulty has been that measures of technology use have been based on respondents' knowledge of specific technologies and not how technology has been used. Disconnecting technology from appropriate use provides a weak picture of its impact (Clark, 1983). In this study an instrument was developed that simultaneously addressed general technology background, self-perceptions of technology competence, knowledge of specific technologies, descriptions of how those technologies were used in instruction, and attitudes toward technology use based on the International Society for Technology in Education (ISTE) National Educational Technology Standards for Teachers (http://cnets.iste.org/). In all, respondents completed 84 questions on a four-page survey.

A number of iterations of the survey questions were reviewed for validity by an ISTE researcher who was working with the grant as an external evaluator, all seven of the campus coordinators for the grant, and a selection of teacher education faculty from one of the participating institutions. Reliability was judged by computing a Cronbach's Alpha for the Technology Knowledge section of the survey (.92) and the Technology Attitude section of the survey (.93).

The majority of the student teachers completed the paper and pencil survey at the same time in a conference setting. Most faculty were contacted by grant campus administrators for each institution and returned the completed surveys to them. All of the surveys were completed in the beginning of the fall semester of the academic year.

Demographic data collected on the instrument included gender, approximate age (measured by the date a bachelor's degree was awarded), teaching content area, and endorsement/licensure level. Additionally, respondents were asked to assess their level of competence with computers (non-user, minimally skilled, moderately skilled, accomplished, and expert).

Respondents selected from a four-point scale, anchored by "I am highly skilled in integrating this into my teaching and other professional work" and "I know what this is but I seldom use it," to report their knowledge concerning 23 electronic technologies separated into three categories. A fifth response category of "I don't know what this is" was also provided as a separate analysis category.

The specific survey items and the categories into which they were sorted are listed below.

Data Management Tools

Word processing
Spreadsheets
Databases
Presentation software
Bibliographic data base (e.g. ERIC, EBSCO)
Bibliographic publishing software (e.g. EndNote)
Statistical software
Qualitative analysis software

Web-Based Tools

Email
Other on-line communication tools (e.g. chat, bulletin boards)
Web browsers and data access tools (e.g. Explorer, Netscape Communicator, Fetch, WinFTP)
On-line instructional support software (e.g. Blackboard, WebCT)
Web publishing tools (e.g. Composer, Frontpage)

Digital Manipulation Tools

Graphing calculators
Graphing software
Graphic organizer or concept mapping (e.g. Inspiration)
Hypermedia authoring tools
Graphics software (e.g. Illustrator, Photoshop)
Scanners
Digital cameras
Video editing
Midi or other digital audio software
Digital sensors and laboratory tools (e.g. probeware, digital microscopes)

Respondents indicated their attitudes toward uses of technology in education based on a series of 16 questions developed from the ISTE National Educational Technology Standards for Teachers. This series of Likert style questions has been used in large-scale studies of teacher technology attitudes (Brown, 2001). One additional question concerning the impact that infrastructure issues had on the decision to use instructional technology was added, and based on the identification of the influence of this issue on teachers' continued use of technology in classrooms (Eifler, Greene & Carroll, 2001).

In a section of the survey immediately following the technology knowledge section, respondents indicated how they used each of those items in their classrooms. Response categories included,

I expect students to know how to use this before they come to my course.

I have assignments, which require students to use this.

I use this during teaching.

I explicitly instruct students on the use of this.

Although responses to these questions may have influenced responses to the technology attitudes questions in the final section of the survey, this section is not directly pertinent to the identification of differences in technology competencies between faculty and students, and is therefore not analyzed in this paper. Additionally, most students had very little classroom experience from which to judge their use of technology in instruction.

Categories on technology competency questions were constructed to allow group mean comparisons between faculty and students. Responses to the Likert scale technology attitude questions were also analyzed in this manner. All analyses were completed as two-tailed tests.

Results

A total of 378 student teachers completed the paper and pencil survey in September at the beginning of their student teaching year. Fifty-one School of Education faculty members from the six participating institutions completed the survey at approximately the same time. This sample represents about 72% of the available student teachers and 65% of the faculty members from the six target institutions. Three respondents did not indicate their status as student or faculty member and were removed from the analysis.

Considerable evidence (i.e. Volman & Van Eck, 2001) has shown that important differences exist between males and females in terms of accessibility, use, and attitudes toward educational technology. In this study the faculty respondents consisted of 31 males and 18 females, and the students included 89 males and 288 females.

The average number of years since faculty members had received their bachelor's degree was 25.39. There was not a significant difference between male (25.63) and female (24.92) faculty on this measure. The average number of years since students had or would receive their bachelor's degree was 1.96. Female students (1.22) received their degrees significantly more recently than males (4.28, $p < .0001$).

Self-reports of technology competency were similar for faculty and students (Table 1). Results differed from what would be expected ($p < .05$) when the two groups were separated by gender. A chi square was used to compare male faculty, male students, female faculty, and female students simultaneously. A number of large percentage differences appeared. Female faculty were less likely to rate themselves as accomplished than other groups and more likely to rate themselves as moderately skilled. Students were less likely to rate themselves as expert than faculty. Female students were most likely to rate themselves as minimally skilled, and male students were least likely to rate themselves in that category.

Using a comparison of group mean differences, faculty reported significantly greater skill than students with four electronic technologies (Table 2): spreadsheets, presentation software, statistical software, and digital sensors. Students reported significantly higher skill levels than faculty with two items: on-line communication tools and graphing calculators. With 2.5 as a mid-point in the skill range, faculty averaged with word processing, spreadsheets, presentation software, e-mail, and internet browsers at the 2.5 skill level or higher. Students averaged word processing, bibliographic databases, e-mail, on-line communications tools, and internet browsers at the 2.5 skill level or higher.

Of the 23 electronic technologies listed, over a third of the faculty indicated they did not know what six of them were—qualitative analysis software, graphing calculators, graphic organizers, hypermedia software, midi, and digital sensors. Over a third of the students reported they did not know what nine of the list were—bibliographic software, statistical software, qualitative analysis software, Web publishing tools, graphic software, graphic organizers, hypermedia software, midi, and digital sensors.

Of the 16 questions addressing themes of the National Educational Technology Standards for Teachers (Table 3), faculty indicated significantly stronger agreement than students with two items—I regularly use technology to communicate and collaborate with students; When designing instructional activities, I regularly include technologies where

Table 1: Percentage Distribution of Respondents' Self-perception of Technology Competence

	N	Non-User	Minimally Skilled	Moderately Skilled	Accomplished	Expert
Total Faculty	49	0.00	12.24	59.18	22.45	6.12
Total Students	377	0.27	15.14	56.49	27.30	0.81
Male Faculty	31	0.00	12.90	51.61	29.03	6.45
Male Student	89	0.00	8.05	64.37	25.29	2.30
Female Faculty	18	0.00	11.11	72.22	11.11	5.56
Female Student	288	0.35	17.31	54.06	27.92	0.35

Chi Sq. p < .05 (comparison of male faculty, male student, female faculty, female student cell values)

Table 2: Mean Scores of Self-perceptions of Skill Level with Specific Electronic Technologies (1 =minimal skill; 4 = high skill)

	Mean Score (number responding)		Percent responding "I don't know what this is"	
Data Management Tools	Faculty	Students	Faculty	Students
Word processing	3.47 (49)	3.42 (375)	0	.27
Spreadsheets	2.61 (49)	2.23 (363)*	0	3.47
Databases	2.02 (47)	1.93 (341)	2.04	8.80
Presentation software	2.68 (47)	2.16 (351)**	2.04	6.40
Bibliographic data base (e.g. ERIC, EBSCO)	2.34 (44)	2.51 (292)	8.16	20.80
Bibliographic publishing software (e.g. EndNote)	1.45 (33)	1.75 (173)	30.61	53.07
Statistical software	2.00 (38)	1.52 (223)**	22.45	40.53
Qualitative analysis software	1.60 (25)	1.44 (144)	46.94	61.33
Web-Based Tools				
Email	3.67 (49)	3.61 (375)	0	0
Other online communication tools (e.g. chat, bulletin boards)	1.87 (47)	2.74 (369)***	4.08	1.33
Web browsers and data access tools (e.g. Explorer, Netscape Communicator, Fetch, WinFTP)	3.22 (49)	3.22 (371)	0	1.07
Online instructional support software (e.g. Blackboard, WebCT)	2.31 (48)	2.44 (319)	2.04	14.40
Web publishing tools (e.g. Composer, Frontpage)	1.77 (44)	1.70 (244)	10.20	34.67
Digital Manipulation Tools				
Graphing calculators	1.72 (35)	2.27 (322)**	26.53	14.13
Graphing software	1.97 (37)	1.67 (280)	22.45	25.07
Graphic organizer or concept mapping (e.g. Inspiration)	1.67 (36)	1.62 (235)	26.53	37.33
Hypermedia authoring tools	1.50 (30)	1.54 (140)	38.78	60.80
Graphics software (e.g. Illustrator, Photoshop)	1.95 (42)	1.98 (308)	14.29	16.27
Scanners	2.10 (48)	2.17 (358)	2.04	5.07
Digital cameras	2.15 (48)	2.28 (360)	2.04	4.27
Video editing	1.47 (43)	1.47 (309)	10.20	16.53
Midi or other digital audio software	1.37 (35)	1.49 (239)	26.53	35.47
Digital sensors and laboratory tools (e.g. probeware, digital microscopes)	1.81 (31)	1.25 (177)*	34.69	52.27

**** = p < .05, ** = p < .01, *** = p < .0001***

appropriate. Students indicated significantly stronger agreement than faculty with two items—When selecting technologies, I regularly refer to current research on their effectiveness; My courses address social, ethical, and legal implications of technology. It should be noted, however, for both of these items a large percentage of students responded that the items did not apply.

Table 3: Mean Score of Technology Use Based on National Educational Technology Standards (1 = Strongly Disagree; 4 = Strongly Agree)

	Mean Score (Number Responding)		Percent Indicating "Does Not Apply"	
	Faculty	Students	Faculty	Students
I regularly use technology to collaborate with peers (e.g. e-mail, bulletin boards, listservs, chat, online editing).	3.66 (47)	3.49 (354)	2.04	2.38
I regularly use technology to communicate and collaborate with students (e.g. e-mail, bulletin boards, listservs, chat).	3.53 (47)	3.04 (250)**	2.04	28.04
I regularly use technology to increase my own professional growth (e.g. technologies related to remaining current, research, or publications).	3.53 (47)	3.39 (353)	4.08	2.38
I regularly use technology to individualize instruction and to meet the needs of diverse learners.	2.88 (41)	3.03 (246)	14.29	27.25
I regularly design technology based instructional activities that require students to access information and interpret, organize, and represent what they know.	2.86 (44)	2.61 (219)	10.20	33.86
I am comfortable planning instructional activities that use technology as a support or delivery system.	3.00 (46)	2.99 (317)	6.12	10.05
I am comfortable planning class sessions that involve student access to technology during instruction.	2.98 (44)	2.92 (310)	6.12	11.90
I am comfortable with the level of institutional support I receive for using technology in my work.	3.08 (48)	2.85 (242)	2.04	26.19
When designing instructional activities, I regularly include technologies where appropriate.	3.20 (46)	2.90 (251)*	2.04	24.34
When considering the use of instructional technologies the adequacy of the infrastructure is my main concern.	2.49 (41)	2.65 (197)	12.24	34.92
When selecting technologies, I regularly refer to current research on their effectiveness.	2.28 (43)	2.68 (255)*	6.12	23.28
I remain current on technologies related to my field.	2.62 (45)	2.71 (311)	4.08	10.85
I remain current on technologies related to instruction.	2.57 (46)	2.76 (306)	2.04	10.85
My courses address social, ethical, and legal implications of technology.	2.34 (44)	2.74 (211)*	6.12	33.86
I regularly use technology to manage my courses (e.g. grade books, on-line syllabi or other course materials).	3.26 (47)	3.24 (244)	2.04	27.78
I have effective strategies for assessing students' technology-supported work.	2.37 (41)	2.66 (189)	8.16	40.48

***** = $p < .05$, ****** = $p < .001$

Using the midpoint of the Likert scale to separate responses into generally agree and generally disagree, the students' mean scores indicated general agreement with all of the items. Faculty generally disagreed with four items:

- When considering the use of instructional technologies, the adequacy of the infrastructure is my main concern.
- When selecting technologies, I regularly refer to current research on their effectiveness.
- My courses address social, ethical, and legal implications of technology.
- I have effective strategies for assessing students' technology-supported work.

Discussion

A particularly strong indication that there is not a substantial difference between faculty and student technology competencies is the data concerning general perceptions of technology competency. The distributions of responses for faculty and students are surprisingly similar. Only female faculty seemed less willing to suggest their competence as accomplished.

From this study, little evidence exists that there are important differences between faculty and student competencies in the use of educational technologies. The three applications of technology with which both faculty and students indicate the greatest skill are e-mail, word processing, and Web browsers. Where significant differences do appear, the differences seem understandable. For faculty, differences indicated greater skill than students with spreadsheets, presentation software, statistical software, and digital sensors. These are all items that faculty are more likely to use frequently as part of their daily work than students who have yet to hold teaching positions. Students reported greater skill with on-line communication and graphing calculators. Most faculty members in this study received their bachelor's degrees before extensive use of graphing calculators appeared in classrooms and would be less likely to have had further contact with them unless they were involved in a content area that currently used graphing calculators.

The differences in the use of on-line communication tools may be the most distinctive indicator in the study of the impact of generational differences on technology use. Research has pointed to patterns of technology use as being age related (Howard, Raine & Jones, 2001). Popular press discussion indicates that younger technology users have considerable experience using the Internet as a communication tool, including on-line chat (i.e. Mangis, 2003). The substantial difference ($p < .0001$) in the reported skill level with on-line communication tools in this study further support these assumptions.

Other than on-line communication tools and graphing calculators, greater percentages of students than faculty consistently reported no knowledge of specific technologies. This finding would seem to indicate that faculty are more versed in educational technologies than students.

Equally, faculty and students had agreement with the statements surrounding the NET standards. This is somewhat surprising considering that the majority of the students had had very little classroom experience by the time they completed the survey. The positive responses from the students may be related to activities that they had completed as part of educational technology courses they had experienced in their programs. Regardless, the responses to these questions indicate that faculty and preservice teachers may be closer to understanding and applying classroom technology standards than is generally believed.

Conclusion

Not surprisingly, all groups showed the highest knowledge and instructional use of word processing, e-mail, and browsers (Internet access) with no significant differences among them. What was of more interest was that few differences appeared between the groups, with most of the remainder of instructional technologies listed on the survey. Faculty and student teachers alike seemed to be poorly versed in everything from graphing calculators to video editing software. Because the focus of this paper was to compare faculty and student knowledge, data gathered for this study cannot address the rather surprising finding that many of the respondents did not know of the existence of many common technologies.

This study provides an interesting early view as an initial attempt to identify technology competency differences between education faculty and their students. The most glaring difficulty with the study is the reliance on self-report data. Most people perceive their skill in using technologies in relationship to their success in accomplishing the tasks undertaken. Different individuals who all believe themselves to be highly competent in using word processors for instance, may be making that judgment based on very different abilities with the software. Further studies need to gather data more directly from observations of individuals using educational technologies.

Another possible concern is the generalizability of the findings of this study. Because the sample came from private liberal arts colleges, it may be that the sample is not representative of faculty and students in both public and private teacher education programs. In addition, every discipline is unique in terms of the knowledge of technology appropriate to the area of study and possibly in terms of those who are drawn to the discipline. Further research needs to look at a greater variety of students and faculty in a wide assortment of disciplines across campuses.

Also of concern is that by selecting students that are at the end of their educational programs, and additionally students in graduate programs, the results may be less distinct than if younger students had been surveyed. If differences in technology use and understanding are, if fact, generational then there may not have been sufficient distance between the faculty and students in terms of age for differences to appear in this study. Further work should sample students from more distinct age levels.

Regardless, the aphorism "if you don't know how to do something with computers just ask your students" may not be supportable. Capable students who have technology skills in advance of their faculty and other students do appear in many courses, but this study indicates that they are more likely to be an anomaly than the general rule. If it is important to insure that students have technology skills related to the disciplines that we teach, then we cannot assume that the students will come with those skills. Schools of education must identify what skills are important for students to possess. Additionally, this will require that schools of education determine the degree to which they are responsible for helping students gain those technology competencies. We cannot assume that our students' experiences before they enter our classes will have provided them with the technological expertise required both for teacher education programs and for a lifetime of teaching.

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