

Physical Educators' Technology Competencies and Usage

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Abstract

The purpose of this study was to examine K-12 physical education teachers' perceptions of ability and usage of technology. Physical educators (n=114) completed the Physical Education Technology Usage Survey assessing their perceived technology competency, how and why they utilize technology, challenges they face in implementing technology, and where they learned to use technology. Results indicated a high level of perceived competency with many forms of technology but differences based on gender, teaching level, and years of experience. Low competency levels were shown for website creation, PDAs, heart rate monitors, and body composition analyzers. The teachers reported that student learning can be enhanced with technology because it aids the visual learner, facilitates individual development, and is useful for assessment purposes.

As society becomes increasingly high-tech, schools are expected to keep up with technology advances and prepare students with the skills needed to use technology effectively. This expectation has been explicitly articulated in technology standards. The National Educational Technology Standards (NETS), established by the International Society for Technology in Education (ISTE) (2000), include separate sets of standards for teachers, students, and administrators. Forty-nine states have "adopted, adapted, aligned with, or otherwise referenced at least one set of standards in their state technology plans, certification, licensure, curriculum plans, assessment plans, or other official state documents" (ISTE, 2004). In addition to the NETS, two organizations have specifically targeted physical educators with standards related to technology, the National

Association for Sport and Physical Education (NASPE) and the National Board for Professional Teaching Standards (NBPTS). NASPE dedicated a standard solely to technology in its standards for beginning physical education teachers (NASPE, 2003). The NBPTS, in its assessment process for certification, requires a demonstration of content knowledge by physical educators in "...appropriate uses of technology for effective physical education instruction" (National Board, 2003, np). A bevy of articles in the recent physical education literature have addressed technology and included strategies for meeting the technology standards (Fiorentino & Castelli, 2005; Mohnsen, 2005a; Mohnsen, 2005c) as well as current types of technology and their applications in physical education (Dunn & Tannehill, 2005; Mohnsen, 2005b; Schlatter & Hurd, 2005; Silverman, 1997; Trout & Zamora, 2005; Wegis & van der Mars, 2006).

The available technology includes what is common for most subject areas: computers (desktop, laptop/notebook, handheld), video recording equipment, projectors, interactive presentation boards (e.g., SmartBoard®), audio systems, and computer productivity software programs such as word processing, electronic presentation programs, spreadsheets, data bases, and grading programs; as well as technology that is specific to physical education. This includes exercise equipment that provides information electronically related to time, distance, speed, cadence, and caloric expenditure (e.g., treadmills, elliptical trainers, and cycling trainers); body composition analyzers such as bioelectrical impedance devices and electronic skin-fold calipers; and physical activity recording instruments including accelerometers, heart rate monitors, pedometers, and interactive dance machines. A number of software programs have

been designed especially for physical education applications, too. These can be used to record and analyze physical fitness, physical activity levels, and nutrition habits, such as TriFit™, FitnessGram®, ActivityGram®, and DineHealthy®. Also, the PE Manager™ program is available to help physical educators immediately track student performance via rubrics, tests, and assignments on a handheld personal computer (PC).

Whereas technology and expectations to apply it exist, various factors have been associated with the level of its implementation in education. Some of these factors have been associated with the teaching context such as technology availability, physical activity time, and budget. Other factors are related to the physical educator and include teaching experience, gender, technology skills, and teacher attitude towards technology. Teachers with fewer years of experience were found to use technology more than those with more years (Dorman, 2001; Lam, 2000). This finding has been explained by the likelihood of younger teachers to have had more experience with technology than older teachers (Matthews & Guarino, 2000). Matthews and Guarino also found that male teachers were more likely to use technology than females. Obviously, teachers must have opportunities to implement technology (LaMaster, 1998) and the skills to do so. The availability of technology, especially in physical education, and the technology skills of teachers vary from school to school (Ince, Goodway, Ward, & Lee, 2006). The high cost of technology affects its availability and must be weighed out against other education needs (Postman, 2000). When physical education budgets are already stretched thin with other equipment needs, technology may not be well supported. Sometimes the technology is provided without adequate training (Silverman, 1997) or teachers do not take advantage of available training (U.S. Department of Education, 1999). Teacher attitude towards technology may play a role in this. Ritson (1995) pointed out that teachers must have the desire to use technology in order to integrate it into their curriculums. Other

research found that many teachers have negative attitudes toward technology and those attitudes inhibit technology use (Clark, 2000). Ince et al. (2006) showed that technology training can improve both skill competency and attitude towards technology. This finding is salient because it supports self-efficacy theory as a meaningful conceptual framework for exploring technology implementation by physical education teachers.

Self-efficacy “refers to beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura, 1997, p. 3). It is a key component of social cognitive theory which explains human behavior as being influenced by environmental factors (equipment, facility, training support, etc.) and personal factors (individual cognitions about self-efficacy, attitudes, etc.) (Carron, Hausenblas, & Estabrooks, 2003). For example, a physical educator’s technology implementation would be influenced by the availability of the technology and training received and the success or non-success of the implementation would mediate the educator’s beliefs in his or her technology competency. These beliefs would then influence future implementations. While other factors, especially contextual factors outside of the teachers’ control, mediate technology implementation, understanding how physical educators view their technology competencies would provide valuable information about whether the teachers believe they have the skills needed to implement technology as expected by the standards. The information would be useful, too, for making decisions related to technology training at both the pre-service and in-service levels. How physical educators are currently using technology is also important information as it can expand the knowledge of pedagogical practices in the field, especially in response to changing expectations.

The purpose of this study was to examine physical education teachers’ perceptions of their ability and usage of both general and physical education specific technology. The specific questions that guided this study were: (a) To what

degree do physical education teachers perceive their level of competence in using technology specific to physical education? (b) Are there differences in terms of gender, school level, and years of teaching in perceptions of competence and usage of technology (both in general usage and usage specific to physical education)? (c) Where do physical education teachers learn how to use technology? (d) How is technology used within physical education? and, (e) What are the limitations for physical education teachers in utilizing technology in physical education.

Methods

Participants

All K-12 physical education teachers who were members in the Northwest District Association of the American Association of Health, Physical Education, Recreation and Dance (NWD) were invited to participate in this study. A total of 404 teachers, all with listed e-mail addresses, were notified by e-mail and invited to complete the Physical Education Technology Usage Survey for Physical Education Teachers (PETU-PE). The study was approved by a Human Assurance Board and the invitation e-mail informed participants that their completion of the survey implied informed consent. Participant confidentiality was established through the use of identification numbers and was safeguarded by limiting personal information to state, grade level of teaching, years of teaching, and gender.

Data Collection

Data were collected using the PETU-PE survey. The e-mail message inviting teachers to participate in the study contained a link to the online survey. The survey was designed to investigate physical education teachers' perceptions of technology in terms of (a) their perceived competency to use technology in general and technology specific to physical education, (b) where each participant learned to use technology, and (c) teacher usage of technology in physical education classes.

Initial development of the PETU-PE was aligned with the National Education Technology for Teacher (NET-T) standards. Three physical education professors and two graduate students in physical education evaluated the instrument for content, construct, and flow and revised it. Twenty physical education teachers from the Northeast and Southwest responded to a request to pilot the PETU-PE. Reliability for the pilot test was established using Cronbach alphas on items for both general technology and physical education specific technology with alpha results $\geq .90$. Feedback on open-ended questions on the PETU-PE was also requested and these items were modified for better clarity. The pilot indicated that completion of the survey took between 10 and 20 minutes.

The PETU-PE consists of three main sections in addition to participant demographics (see Appendix A). The first section includes thirty-two items in six areas of computer usage: (a) productivity, (b) peripherals, (c) physical education technology applications/basic programs, (d) computer basics/ operating systems, (e) trouble shooting, and (f) design and delivery. For these items, participants selected their level of competency from proficient (an expert and could use the technology independently or for innovative purposes), competent (was literate and felt comfortable with the technology), or beginner (had little or no experience with the technology). The second section contains a list of six types of physical education technology and an option for teachers to write in other types of technology. In this section teachers selected the source(s) where they had learned to use the technology. The final section uses four open-ended questions to assess how and why physical education teachers utilize technology, difficulties physical education teachers face in implementing technology into physical education, and suggestions for effective preparation of teachers in technology.

Data Analysis

Reliability of the survey instrument was checked using Cronbach's alpha on items for both

general and physical education specific technology. Results indicated alpha levels of .97 for general technology and .84 for physical education specific technology. These levels were deemed acceptable since each was greater than .70 (Nunnally, 1978). Frequencies and percentages were calculated for demographic data associated with gender (male and female), school level (elementary, junior high, and high school), and years of teaching (0-5, 6-15, 16-24, and above 25), and for where teachers learned to use technology. Analysis of variance (ANOVA) was calculated to examine the differences in general technology usage and specific technology usage in physical education based on gender, school level, and years of teaching. Tukey post hoc was used when significant main effects were found. Statistical significance was accepted at the alpha level of .05.

A content analysis was used to analyze responses to the open-ended questions related to how and why physical education teachers utilize technology, difficulties physical education teachers face in

implementing technology into physical education, and suggestions for effective preparation of teachers in technology. Responses to each question were coded and categorized by three of the investigators according to accepted qualitative data analysis methods (Lincoln & Guba, 1985) using a 90% inter-rater agreement level. For example, each investigator listed the technology uses physical educators identified and grouped them according to similarities. These categories were checked against the listings of the other investigators. Finally, the relationship between perceived competency and technology usage was conducted through a reverse analysis of the open-ended questions and their relationship to perceived competency.

Results

A total of 114 participants (Female = 75; Male = 38; one unreported) completed the PETU-PE. Demographic data for the participants is presented in Table 1.

Table 1

Demographic Characteristics of Participants

Gender	Males n=38, 33%	Females n=75, 66%	Unreported n=1		
School Level	Elementary n=54, 47%	Junior High n=33, 29%	High School n=22, 19%	n=5	
Years Teaching	1-5 n=32, 28%	6-15 n=28, 25%	16-24 n=25, 22%	≥ 25 n=28, 25%	n=1

Physical Education Teachers' Perceptions of their Competency to Use General Technology

Frequency and percentage data of physical education teachers' perceptions of competency to use general technology are displayed in Table 2. The physical educators indicated that they were beginners if they had little or no experience with technology, competent if they were literate and comfortable with technology, and proficient if

they were experts who could use technology independently or for innovative purposes.

ANOVA results demonstrated a significant difference for gender, $F(1, 111) = 10.51, P = .0016$. The post hoc test indicated that male teachers perceived themselves to have higher levels of competence. No significant difference was found in terms of school level, $F(2, 106) = 0.32, P = .73$ or years of teaching experience, $F(3, 110) = 4.22, P = .0073$.

Table 2*Physical Education Teachers' Perceptions of Competency to Use General Technology*

	Beginner	Competent	Proficient
Computer Basic/Operating Systems			
Set up a basic computing system (monitor, mouse, etc) with modem and peripheral hardware (scanner, speaker, etc)	23 (20.2%)	28 (24.6%)	63 (55.3%)
Identify, create, open, use and manipulate various folders, files and disks (floppy, hard drives, etc)	16 (14%)	23 (20.2%)	75 (65.8%)
Identify, access and manipulate various devices, programs and files	22 (19.3%)	23 (20.2%)	69 (60.5%)
Effectively use control panels to affect the operating system environment (monitor, mouse, hard drive, etc)	21 (18.4%)	29 (25.4%)	64 (56.1%)
Manipulate, modify, save and open various applications/programs and files	15 (13.2%)	25 (21.9%)	74 (64.9%)
Work between and manipulate multiple document windows and application programs	18 (15.8%)	24 (21.1%)	72 (63.2%)
Design & Delivery			
Use educational technology in a one (1) to many computer classroom setting	45 (39.5%)	18 (15.8%)	51 (44.7%)
Create distance education delivery lesson plans using educational technology	80 (70.2%)	12 (10.5%)	22 (19.3%)
Create an educational website	75 (65.8%)	22 (19.3%)	17 (14.9%)
Effectively use, find and replace and insert various types of media (text, graphics, audio, video, etc)	51 (44.7%)	28 (24.6%)	35 (30.7%)
Productivity Applications/Program Basics			
Use a word processor	5 (4.4%)	17 (14.9%)	92 (80.7%)
Use a spreadsheet	19 (16.7%)	24 (21.1%)	71 (62.3%)
Use presentation programs	33 (28.9%)	24 (21.1%)	57 (50%)
Use e-mail	4 (3.5%)	10 (8.8%)	100 (87.7%)
Use the internet	4 (3.5%)	16 (14%)	94 (82.5%)
Use audio file	45 (39.5%)	26 (22.8%)	43 (37.7%)
Peripherals			
Use a scanner	39 (34.2%)	34 (29.8%)	41 (36%)
Use a digital video camera	43 (37.7%)	27 (23.7%)	44 (38.6%)
Use a digital camera	27 (23.7%)	28 (24.6%)	59 (51.8%)
Use a CD burner	42 (36.8%)	20 (17.5%)	52 (45.6%)
Use a LCD Projector	55 (48.2%)	23 (20.2%)	36 (31.6%)
Use a Smart Board	88 (77.2%)	16 (14%)	10 (8.8%)
Use a Zip type drive	60 (52.6%)	26 (22.8%)	28 (24.6%)
Use a VCR	5 (4.4%)	12 (10.5%)	97 (85.1%)
Trouble Shooting			
Install, uninstall, use operating system, anti-virus ware	49 (19.3%)	22 (43%)	43 (37.7%)

Physical Education Teachers' Perceptions of their Competency to Use Technology Specific to Physical Education

Frequency and percentage data for physical education teachers' perceptions of competency to use technology specific to physical education are displayed in Table 3. Results of the ANOVA demonstrated a significant difference between

school level $F(2, 106) = 10.19, P < .0001$, while no significant differences were demonstrated for gender, $F(1, 111) = 0.22, P = .64$, or years of teaching, $F(3, 110) = 0.38, P = .76$. The post hoc Tukey test revealed elementary teachers ($M=17, SD=5.9$) think they are less competent than both junior high school teachers ($M=21, SD=6.4$) and high school teachers ($M=23, SD=4.9$).

Table 3

The Perception of Physical Education Teachers' Competency to Use Technology Specific to the Physical Education Setting

Physical Education Technology	Beginner	Competent	Proficient
Use aerobic equipment (treadmills, stairclimbers, exercise bikes, etc.)	35 (30.7%)	21 (18.4%)	58 (50.9%)
Use timing devices (stopwatch, radar gun, etc)	8 (7%)	27 (23.7%)	79 (69.3%)
Use activity monitors (pedometers, accelerometers, etc)	32 (28.1%)	25 (21.9%)	57 (50%)
Use body composition analyzers (skinfold calipers)	51 (44.7%)	29 (25.4%)	34 (29.8%)
Use heart rate monitors	52 (45.6%)	21 (18.4%)	41 (36%)
Transfer and graphically analyze data from technology devices to database	76 (66.7%)	13 (11.4%)	25 (21.9%)
Use PDAs and associated software	77 (67.5%)	17 (14.9%)	20 (17.5%)

Where Teachers Learned to Use Technology Specific to Physical Education

Results showing where physical education teachers learned to use technology are displayed in Table 4. Seven participants failed to respond to this section of the survey. It should be noted that six teacher responses were write-in comments. Their input showed that some physical education teachers also learn to use technology during internships, at personal gym and health organizations, in exercise science courses, and/or through sport participation.

How Technology Is Used Within Physical Education

How teachers use or do not use technology in physical education was revealed via a content analysis of each open-ended question. Three

themes emerged from the question asking how physical education teachers use technology to enhance student learning. Student learning was thought to be enhanced because technology facilitated: (a) aiding the visual learner, (b) individual development and (c) student assessment.

Aiding the visual learner.

The teacher responses associated with aiding the visual learner focused on the incorporation of televisions, digital cameras and LCD projectors. A male teacher demonstrated the importance of technology and student learning by showing "videos that involve instruction of various activities" and used "digital pictures to show proper athletic position and game strategy." Some teachers utilized LCD projectors to aid in teaching different activities. For instance, a male teacher

Table 4
Where Physical Education Teachers Learned About Technology Related to Physical Education

	Pedagogy Course	Foundation Course	Technology Course	K-12 Practicum	Professional Development (Workshops, Conferences)	Did not Learn	Learn on own	Other
Aerobic Equipment	11 (10.3%)	11(10.3%)	1 (0.9%)	6 (5.6%)	23 (21.5%)	31 (28.9%)	15(14%)	9 (8.4%)
Timing Devices	16 (15%)	19 (17.8%)	2 (1.9%)	30 (28%)	19 (17.8%)	14 (13.1%)	13(12.1%)	8 (7.5%)
Activity Monitors	9 (8.4%)	10 (9.3%)	4 (3.7%)	12 (11.2%)	48 (44.9%)	19 (17.8%)	7 (6.5%)	1 (0.9%)
Body Composition Analyzers	16 (15%)	20 (18.7%)	1 (0.9%)	5 (4.7%)	37 (34.6%)	19 (17.8%)	7 (6.5%)	5 (4.7%)
Heart Rate Monitors	8 (7.5%)	9 (8.4%)	3 (2.8%)	11 (10.3%)	47 (43.9%)	25 (23.4%)	9 (8.4%)	3 (2.8%)
PDA's (PalmPilot)	3 (2.8%)	3 (2.8%)	4 (3.7%)	7 (6.5%)	26 (24.3%)	57 (53.3%)	9 (8.4%)	6 (5.6%)

* Teachers could select more than one option and percentages are based on the 107 teachers who responded to this section.

stated that he uses "PowerPoint presentations of non-traditional activities." Similarly, a junior high school physical education teacher uses a "multi-media projector to project Tai-Bo workouts, along with other workouts."

Facilitating individual development.

The teachers indicated that students' individual needs were enhanced through the use of fitness software, pedometers, heart rate monitors and videotape analysis. The use of pedometers and heart rate monitors were used to demonstrate individual students' level of physical fitness, time spent in their target heart rate zone and level of participation in class activities. As one female, high school teacher stated, "heart rate monitors are used extensively in class... Students must meet heart rate goals." Along with fitness and activity development, technology was implemented to aid in the development of individual skills by using videotape analysis. Videotape analysis provides the students with a personal view of their skill performance and can be used to reinforce proper mechanics and to correct errors. For instance, a high school teacher stated, "I use a video camera to video tape students performing certain skills so they can see what they are doing right or wrong." The physical education teachers believed that technology facilitated making learning more meaningful by focusing on the individual development of each student.

Student assessment.

One means of utilizing technology for skill assessment focused on videotape analysis of different sports skills using a pretest-posttest design. For example, a teacher indicated that she assessed her students on throwing and catching "both before and after, using a video camera." This strategy allows both the teacher and students to focus on performing skills using correct form rather than only on results. For example, technology is not required to assess whether the ball hit the target or not but does reveal student learning of proper mechanics in throwing.

The teachers also indicated that they used technologies like pedometers, heart rate monitors, computer software and timing devices to assess individual student development. These tools are used by the student to gather personal fitness data and develop an individualized fitness or workout program. As one teacher stated, "students input fitness scores in a computer." Technology allows the student to better understand his/her unique strengths and/or weakness. Physical education teachers commonly used timing devices and computer software to gather and input data on their student fitness scores. For instance, a teacher stated that she used the "Presidential Physical Fitness program to assess student's fitness level." From this information students can begin to understand and develop a specific plan for their fitness success and to track their progress over time. "Pedometers and heart rate monitors are used to record personal bests in personal PE journals that are kept K-12." These uses of technology for assessment aid in the individual development of students and help provide a record of their development.

Technology also provides the teachers with convenient methods of record keeping. Student grades, equipment lists and weekly reports were commonly cited record keeping uses for technology. As one elementary level teacher stated, "I have used Easy Grade Pro with a Palm Pilot for grading purposes."

Limitations for physical educators in utilizing technology in physical education.

The content analysis of each open-ended question focused on reasons why technology is not used and the impact of budget on technology. Results of the content analysis indicated that physical education teachers' reasons for not using technology included (a) financial concerns and accessibility, (b) lack of class time, (c) training needs, and (d) inadequate space.

Financial concerns and accessibility.

The most frequently cited concern for physical education teachers was in the area of financial

constraints. Many comments focused on the need and interest in using technology, but limited budgets negatively impacted the incorporation of technology in physical education. One female elementary teacher stated, "I don't use it (technology) as much as I would like to because of lack of funding." Limited accessibility to technology appeared to parallel the money concerns as many teachers indicated that they did not have adequate technology. For instance, a junior high school teacher stated that the school had PDA's, but did not have the correct software to utilize the information.

Lack of time.

The respondents also believed that the use of technology took away from precious activity time. This was clearly indicated at the elementary level where physical education teachers have limited class time and would rather focus on skill and physical activities. The teachers' concern that technology would rob students of activity time was evident in comments like, "My elementary classes are only 25 minutes in length," and "I have previously used heart rate monitors and found them to be... time-consuming."

Training needs.

Some physical education teachers stated that they did not possess adequate knowledge to properly implement technology in the classroom.

There was a clear interest by many who believed that technology was an important skill, but lacked proper and effective understanding of how to use it.

Inadequate space.

Finally, a small number of respondents stated that there was not enough room, either in the gym or for storage, to add technology to the class. For instance, one teacher stated that technology is "too cumbersome with the number of kids we have in each class." Another added, "We do not have the space available to set up a fitness lab."

Impact of the Budget on Technology Use in Physical Education

School administrators throughout the United States claim that money is the leading cause for limited technology in schools (Coley, Cradler, & Engel, 1997). To determine if a relationship existed between budget and available technology in physical education, teacher responses to the open-ended questions were analyzed according to two budgetary groups: (a) schools with an average, annual budget at or below \$500 dollars and (b) schools with an average, annual budget above \$500 dollars. Results of this analysis are presented in Table 5. Teachers in schools with an average budget above \$500 utilized physical education technology more than those with less than \$500.

Table 5

Relationship Between Budget and Technology Usage

	≥\$500	N	<\$500	N	Total N
Aerobic	0%	0	100%	6	6
Timing Devices	25%	2	75%	6	8
Activity Monitors	41.4%	17	58.6%	24	41
Body Comp	14.3%	1	85.7%	6	7
Heart Rate Monitors	22.2%	6	77.8%	21	27
Database	46.9%	15	53.1%	17	32
PDA	46.2%	6	53.8%	7	13

Suggestions on Preparing Physical Education Teachers to Use Technology

Better preparation and training for the use of technology in physical education was squarely placed at the teacher preparation and professional development levels by the teachers in this study. They indicated that beginning teachers should learn skills needed to effectively apply technology in physical education in their teacher preparation programs. As for themselves, the veteran teachers believed that effective workshops and in-service programs were the best means for them to get adequate technology skill training. They also suggested that an in-house technology expert could aid in the implementation of technology. A few physical education teachers stated that in-service and workshops provide a limited opportunity to learn, whereas an expert could provide knowledge and facilitate them to effectively use current technology and keep up with the ever changing nature of technology.

The Relationship between Perceived Competency and Technology Usage

An investigation into the relationship between perceived competency and technology usage was

conducted through a comparison of the content analysis of teacher's responses to the open-ended questions about technology usage for student learning and assessment in physical education and their responses to items associated with their perceived competency to use the different technologies. For example, responses indicating that a teacher used timing devices in his physical education classes were compared to his perceived competency rating for timing devices. If the physical educator indicated that his competency to use timing devices was at or above the literate and comfortable level, then he was categorized as consistent. If, on the other hand, she indicated using timing devices and reported her competency level for using timing devices at the beginner level, she was categorized as inconsistent. Results of the data analysis are provided in Table 6. They indicate that some teachers are utilizing technology even though they perceive their competency at a low level.

Discussion

Overall, the physical educators in this study indicated that they were proficient in using technologies common to educational settings such

Table 6

Relationship between Perceived Competency and Usage of Technology in Physical Education

	Consistent	N	Inconsistent	N	Total N
Aerobic	100%	6	0%	0	6
Timing Devices	100%	8	0%	0	8
Activity Monitors	93%	38	7%	3	41
Body Comp	62.5%	5	37.5%	3	8
Heart Rate Monitors	89.3%	25	10.7%	3	28
Database	40.5%	17	59.5%	25	42
PDA	38.5%	5	61.5%	8	13

as e-mail, the internet, and VCRs. Yet how the teachers used the technology was not well specified, with the exception of VCRs used for assessment and instructional purposes. Martens (1997) indicated that “the computer and telecommunications networks, especially the Internet, are revolutionizing education” (p. 251) and one study showed that physical educators who were participants of a listserv used it to share professional concerns, lesson ideas, instructional strategies, and technology applications (Pennington, Wilkinson, & Vance, 2004). The explosion of resources available on the internet and the potential of listservs and e-mail for improved networking among physical educators render these technologies open for further exploration of how and why physical educators use them.

As for technology specific to physical education, the teachers in this study perceived themselves as competent in some of it, especially timing devices, aerobic exercise equipment, and activity monitors (primarily pedometers). The teachers believed they were beginners in using databases, handheld PCs and software, heart rate monitors, and body composition analyzers. While databases are useful for record keeping purposes and the educators indicated they used technology for that purpose, other software such as spreadsheets and grading programs may better fit the needs of physical educators. Further research is needed to determine in which specific technologies physical educators need competencies. The physical education technologies that the educators reported lower proficiency in are useful tools for two of the reasons that they reported for using technology. The handheld computers and available software provide a means for teachers to efficiently record assessments of student performance, in both behavioral and sport skill development. Their size and portability allow the teachers to overcome a couple of the challenges they cited to using technology, too. Although heart rate monitors do pose a challenge of time required to educate students in their use, outfit the students each day, and record the data, they do provide an accurate means of providing students with

individual feedback for appropriate intensity levels of physical activity as well as serving as a visual aid to learning. And, for teachers concerned about student effort level, heart rate monitors are a valid means of assessing it. Heart rate monitors may be more applicable in secondary level physical education classes where teachers typically see their students more often and for longer periods of time. A number of issues may be related to the educators’ low proficiency rating for body composition analyzers. Body composition is receiving more attention as a fitness component in light of the nation’s obesity epidemic, however, physical educators we work with have indicated they are reluctant to emphasize measurement for fear of potentially escalating eating disorders. How widespread this thinking is among physical educators and its influence on measurement of body composition needs more examination. Also, electronic body composition analyzers, whether measuring body fat via bioelectrical impedance or skinfold caliper methods, may not be highly prioritized due to their cost and the limited budgets available to the educators. Skinfold measurement of body fat also requires training in order to get valid and reliable results and it takes more time to conduct than using body mass index (BMI), an acceptable and low cost means of reporting body composition (Centers for Disease Control, 2005). BMI requires only height and weight measurements and can be quickly calculated by using a spreadsheet formula, formulas provided on different internet websites, or by available fitness programs such as *FitnessGram*

More research is needed to clarify the role of gender in perceived technology competency among physical educators. This study found no gender difference in technology specific to physical education but found that males perceived themselves to be more competent in general technology. This second result is consistent with previous research that indicated males were more comfortable with technology. This may be because increased use of technology by males, beginning in childhood, appears prevalent (Durdell, 1990; Wood, 2000) and likely contri-

butes to their comfort with it. Wood emphasized the early emergence of gender differences in technology. Students in early elementary grades were equally enthusiastic about technology; but interests took different directions by grades three or four with males being more inclined to play computer games and surf the internet than girls. Durndell, in a report on university level students, reported that males had more experience with and used computers more than females; yet females had generally positive attitudes toward computers and viewed them as useful for given purposes. The female physical educators in this study did not differ from males in their perceptions of competency in physical education specific technology, however. This result is not consistent with the previous research on teachers and technology and may be due to both males and females having had similar levels of experience with this technology.

Another finding in this study that was inconsistent with previous research was that less experienced physical educators did not indicate more competencies with technology. Teacher comments on qualitative items indicated that these teachers valued continuing professional development in technology and it may provide the best means for overcoming the lack-of-knowledge challenge cited by the educators as the reason for not using technology. In-service workshops and the availability of a technology expert were the recommendations of these teachers to help experienced teachers keep abreast of technological advances. Teachers in this study were all members of a regional-level professional organization and may have kept more abreast of technological advances via conference workshops than non-members. The finding that teachers were using up-to-date technology even though they considered themselves at the beginner competency level was somewhat surprising and reinforces the need for continued professional development opportunities with technology. The physical educators also believed that novice teachers should be well prepared in technology when they leave their teacher education programs.

This finding is consistent with the beginning teacher standards. More study of how beginning teachers are being prepared in technology competencies is warranted.

Some results of this study were not surprising given the contextual conditions that physical educators face. The secondary level teachers' higher proficiency levels in technology specific to physical education are probably associated with their curricula, for example aerobic exercise equipment or heart rate monitors, and the longer class times and more frequent meetings with students that are typically available to them. It was also not surprising that teachers cited a lack of time as a reason for not using technology in their classes, especially at the elementary level. Perhaps this is evidence of a failure of the promise of technology to make educators' lives easier. In the revolving-door reality whereby teachers greet one class as the previous one exits the gymnasium, elementary physical educators prioritize activity time and are protective of the few sessions most have each week with their students. The teachers indicated that they believed that technology, rather than contributing to the effective operation of their classes, would rob them of precious activity time. Technology for this level should be designed and marketed as a means to help teachers manage their classes and student learning more efficiently. The technology must be appropriate for the age of the students; that is, it must be durable, easily understood, and efficiently operated by young students. And training for teachers must be effective in highlighting time-saving features of the technology.

The reasons that the teachers did cite for using technology were consistent with the NET standards associated with enhancing student learning and conducting effective assessments. Thus far, much of the technology available to physical education teachers has been designed to meet these purposes and reinforces expectations that teachers be able to use it. This technology includes activity monitors; technology that provides students with visual learning aids such as digital cameras and players, and assessment

equipment in the form of handheld computers and grading programs. The expense of keeping abreast of these technological advances will be a continuing challenge and teachers working within limited budgets will be hard pressed to obtain new equipment and software. Budget planning needs to include considerations for continuing upgrades and grant writing skills may provide the only means for some teachers to procure current technology. More investigation is needed to determine if and how physical education budgets are prepared in light of meeting technology expectations. Postman (2000) pointed out that technology has a high capital cost that limits spending needed in other areas of education such as maintaining the infrastructure, attracting and paying teachers and that education does not necessarily improve just because of improved technologies. Likewise, teachers using technology in response to external and standards-driven forces may not result in improved physical education. Marketers of technology tout only its promise of improving education and making teaching and learning easier. Some light has been shed on the dark side of technology: its cost, dehumanizing effects, and failure to solve important problems (Martens, 1997; Postman, 2000) and the fact that technology will not make a strong teacher out of a poor teacher (Silverman, 1997). Additional study is needed in the area of teachers' use of technology in physical education. Even though technology skill competency is necessary for the implementation of technology, other factors may play a greater role. Questions about which factors most contribute to teachers' use or non-use of technology need to be answered. We can expect continued rapid development in technology and increased pressure to use it in education and should try to keep up with how teachers are dealing with the changes and expectations to use technology.

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Appendix

Physical Education Technology Use Survey for Physical Education Teachers

Completion and submission of this survey will signify informed consent for educational research purposes.

Part I—Technology Competencies. Below you will find statements about various types of technology and technology skills. Read each statement and then select your level of competency as accurately as possible.

Productivity Applications/Program Basics	Proficient—An expert who can use technology independently or for innovative purposes	Competent - Literate and comfortable with technology	Beginner - Little or no experience with the technology
1. Use a word processor (e.g., MS Word or Word Perfect)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Use a spreadsheet (e.g., MS Excel)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Use presentation programs (E.g., PowerPoint)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Use e-mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Use the Internet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Use audio files	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Peripherals	Proficient—An expert who can use technology independently or for innovative purposes	Competent - Literate and comfortable with technology	Beginner - Little or no experience with the technology
1. Use a scanner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Use a digital video camera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Use a digital still camera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Use a CD or DVD burner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Use a LCD projector	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Use a Smart Board	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Use a ZIP drive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Use a VCR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Physical Education Technology	Proficient—An expert who can use technology independently or for innovative purposes	Competent - Literate and comfortable with technology	Beginner - Little or no experience with the technology
1. Use aerobic equipment (treadmills, stair climbers, exercise bikes, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Use timing devices (stopwatch, radar gun, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Use activity monitors (pedometers, accelerometers, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Use body composition analyzers (e.g., skinfold calipers)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Use heart rate monitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Transfer and graphically analyze data from technology devices to a database	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Use hand held personal digital accountants (PDAs) (e.g., PalmPilot, Dell Pocket PC) and associated software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Other—Please describe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Computer Basics/Operating Systems	Proficient—An expert who can use technology independently or for innovative purposes	Competent—Literate and comfortable with technology	Beginner—Little or no experience with the technology
1. Set up a basic computing system (monitor, mouse, etc.) with modem and peripheral hardware (Scanner, speakers, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Identify, create, open, use and manipulate various folders, files and storage devices (e.g., hard drives, zip drives, flash or jump drives)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Identify, access and manipulate various drives, programs and files.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Effectively use a control panel to affect the operating system environment (e.g., set display options, keyboard speed, date and time, internet options, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Manipulate, modify, save and open various applications/programs and files	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Work between and manipulate multiple document windows and application programs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Part III – Your Technology Usage. Please type in responses to the following items.

1. How do you currently incorporate technology into your physical education classes?
2. How have you used technology as part of student assessment?
3. If you are not using technology or using it minimally, describe some reasons why technology has not been used in your physical education classes?
4. Please share any ideas you have about preparing teachers to use technology in physical education.

Demographics

1. What level of physical education do you currently teach? Please select all that apply.
Elementary (grades K-6) Junior High (grades 7-8) High School (grades 9-12)
2. How many years have you been teaching physical education?
3. Gender: Male Female
4. Average yearly physical education budget based on last three years: