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Effect of Physical Education Teachers' Computer Literacy on Technology Use in Physical Education

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Abstract

Teachers' computer literacy has been identified as a factor that determines their technology use in class. The aim of this study was to investigate the relationship between physical education (PE) teachers' computer literacy and their technology use in PE. The study group consisted of 57 high school level in-service PE teachers. A survey was used to assess the PE teachers' computer literacy and instructional technology and media use in PE. Quantitative statistical procedures were performed to analyze the data. The majority of the PE teachers did not often use technology in PE. PE teachers' computer literacy had an effect on their technology use in PE. PE teachers' use of information and communication technologies (ICTs) such as laptops, Internet, and digital cameras showed statistically significant differences in their computer literacy levels (low, average, and high). The surveyed PE teachers tended to not use technology in PE. However, the higher their computer literacy level was, the more likely they were to include technology in PE.

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Technology has become normal and even ubiquitous in everyday life (Horst, 2012). The tech-savvy so-called digital natives (Bennett, Maton, & Kervin, 2008; Prensky, 2001), also known as the Net generation, "naturally" include diverse technologies in their daily routines. The society-wide technology enhancement also includes educational settings such as school. For school-aged children and adolescents, this means they are accompanied by technology not only in their leisure time, but also in their everyday life at school (Nemcek, 2013).

Technology as an instructional method has conquered school classrooms in the meantime (Calvani, 2009). Technology uses in schools have certainly been increased over the past decade (Wastiau et al., 2013). Among the school subjects, physical education (PE) and physical education teacher education (PETE) have been infused with technology as well, at least within the academic discussion and debate (Kretschmann, 2010; Leight & Nichols, 2012; Mohnsen, 2012; National Association for Sport and Physical Education, 2009).

With regard to research findings in the field of technology and PE, the empirical evidence is limited and few empirical studies are available (Kretschmann, 2010). Especially, the PE teachers' perspective has not been in the center of empirical studies so far. The majority of the studies have been focused on PETE students' information and communication technology (ICT) competency and skills (Adamakis & Zounhia, 2013; Z. Goktas, 2012; M. Yaman, 2007a, 2007b). Not much evidence can be found on in-service PE teachers (Kretschmann, 2012; Levent Ince, Goodway, Ward, & Lee, 2006; Tearle & Golder, 2008; Woods, Goc Karp, Miao, & Perlman, 2008; M. Yaman, 2007a). Although some researchers have reported PE teachers' computer literacy and technology use in PE independently (Thomas & Stratton, 2006; Woods et al., 2008), researchers in previous studies did not examine the direct effect of PE teachers' computer literacy on their technology use in PE.

The significance of a supposed direct relationship between PE teachers' computer literacy and their technology use in PE derives from an evidence-based rationale: The effect of teachers' computer literacy on computer use in the classroom has been researched in depth and in manifold studies (Afshari, Abu Bakar, Luan, Abu Samah, & Say Fooi, 2009; Kreijns, Vermeulen, Kirschner, Van Buuren, & Van Acker, 2013). Lack of (PE) teachers' ICT skills has even been identified as a barrier for ICT implementation in the classroom (Buabeng-Andoh, 2012; Tearle & Golder, 2008). Furthermore, PE

may be special among the other school subjects in regard to the exclusive human movement and physical activity content and methods (Newell, 2011; Tinning, 2011) and may therefore not come to mind at first sight, being judged as a nontechnology-related subject (Kretschmann, 2010; Mohnsen, 1997).

Hence, the aim of this study was to investigate the effect of PE teachers' computer literacy on their technology use in PE. PE teachers' computer literacy levels should be determined. In addition, the frequency of PE teachers' technology use in PE should be documented as well.

Method

The study group consisted of 57 high school level PE teachers (M_{age} = 48.84 years ± 1.39). Among the PE teachers, 26 were male (45.6%) and 31 were female (54.4%). Initially, 120 PE teachers were asked to participate in the study. The PE teachers who turned down the request gave nonparticipating reasons such as lack of time, disinterest in the topic, or disinterest in participating in research in general.

A questionnaire survey was used that contained a section for personal data (age, gender), a section for computer literacy, and a section for instructional technology (old and new media) use in PE. The computer literacy section included 10 items, which average scores were pooled into a subscale (M = 2.88 ± 1.02). The items were on a 5-point Likert-type scale (5 = *very good*, 1 = *very poor*) and included aspects according to computer hardware and software functionalities. Reliability analysis of this subscale returned excellent values (Cronbach's α = .90). In the instructional technology section, the PE teachers were asked about the frequency of including instructional technology and media in PE using a 5-point Likert-type scale (5 = *very often*, 1 = *never*) as well.

For the analysis of the collected data, statistical procedures such as correlations, t test, Mann–Whitney U test, one-way analysis of variance (ANOVA), and Fisher's LSD post hoc test were conducted. For all statistical procedures, alpha was set at .05. The statistical procedures were performed using the software IBM SPSS Statistics (Version 21) for Mac OS.

Results

Among the 57 PE teachers, 10 (17.55%) were assessed low-level computer literacy, 26 were on an average computer literacy

level (45.61%), and 21 were grouped into a high level of computer literacy (36.84%). There were no significant differences in the PE teachers' computer literacy regarding gender (*t* test, $p > .05$).

PE teachers' age and computer literacy were significantly correlated (Spearman's rho, $r = .38$, $p < .01$), with a moderate positive relationship. Based on the study groups' average age, this relationship was expected as the emergence of newer ICTs took place after a fair amount of the PE teachers' school and college level education.

The PE teachers' instructional technology-use data clearly highlighted the PE teachers' tendency to not include technology in PE. However, there were two exceptions, namely, stereo systems and images. The PE teachers used them more frequently than other media. Noteworthy, textbooks may have not been regarded as mandatory for PE, as they remained on the same use level as other media and technology. ICT (PC, laptop, and Internet) clearly seemed to be disregarded in terms of integrating in PE classes. Nevertheless, video appeared to have a more prominent standing in regard of usage rate. The complete frequencies of the PE teachers' technology use in PE are shown in Figure 1.

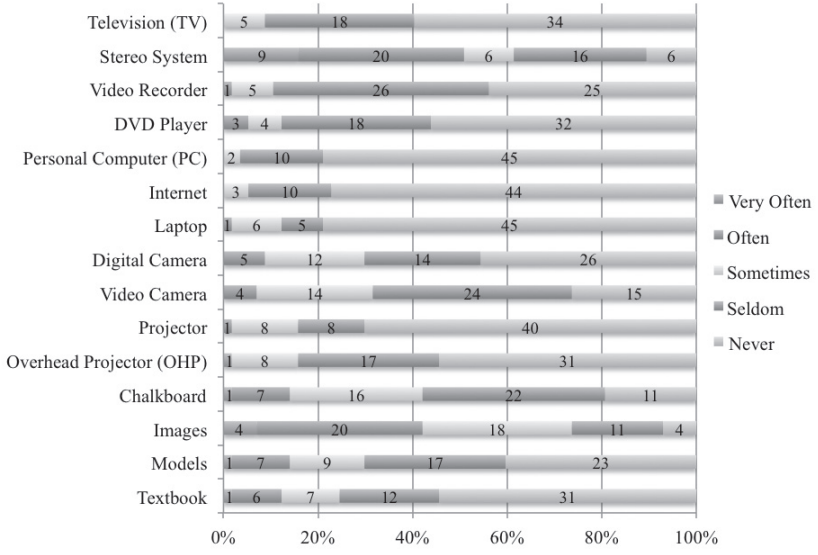

Figure 1. Instructional technology and media use in PE.

In regard to gender, only two of the 15 instructional media showed a statistically significant difference (Mann–Whitney U test, $p < .05$). Stereo system use was significantly different ($U = 100.00$, $z = -5.04$, $p < .001$), as female PE teachers ($M = 3.97 \pm .17$) used stereo systems more frequently than did male PE teachers ($M = 2.23 \pm .17$). Moreover, male PE teachers ($M = 2.00 \pm .19$) used overhead projectors significantly ($U = 241.00$, $z = -2.88$, $p = .004$) more frequently than did female PE teachers ($M = 1.35 \pm .11$).

Among the 15 instructional media, only three (Internet, laptop, and digital camera) showed a statistically significant difference ($p < .05$) according to computer literacy level of the PE teachers. The complete ANOVA results are shown in Table 1.

Table 1
Computer Literacy and Instructional Technology and Media Use in PE

Instructional media	Computer Literacy			F	η^2
	Low	Average	High		
Television (TV)	1.48_{a} (.60)	1.38_{a} (.57)	1.80_{a} (.92)	1.472	.03
Stereo System	3.19_{a} (0.13)	3.19_{a} (0.11)	3.10_{a} (.41)	.020	.00
Video Recorder	1.71_{a} (.78)	1.69_{a} (.68)	1.60_{a} (.70)	.088	.00
DVD Player	1.76a (.94)	1.38a (.64)	1.90a (.99)	1.938	.05
Personal Computer (PC)	1.29_{a} (.56)	1.15_{a} (.46)	1.40_{a} (.52)	.942	.01
Internet	1.08_{a} (.27)	1.33_{ab} (.58)	1.70_{b} (.82)	5.351**	.06
Laptop	1.14_{a} (.48)	1.27_{a} (.60)	2.00_{b} (1.15)	5.566**	.11
Digital Camera	1.57_{a} (.93)	1.92_{a} (.89)	2.70_{b} (1.16)	4.747*	.18
Video Camera	2.05_{a} (.86)	2.04_{a} (.82)	2.50 a (1.08)	1.099	.04
Projector	1.38_{a} (.74)	1.35_{a} (.69)	2.00_{a} (1.05)	2.774	.07

Table 1 (cont.)

Instructional media	Computer Literacy			*F*	η^2
	Low	Average	High		
Overhead Projector	1.43$_a$ (.68)	1.73$_a$ (.78)	1.90$_a$ (1.29)	1.258	.04
Chalkboard	2.00$_a$ (.89)	2.58$_a$ (.81)	2.70$_a$ (1.12)	2.710	.10
Images	2.90$_a$ (1.04)	3.19$_a$ (.98)	3.60$_a$ (1.17)	1.544	.07
Models	1.62$_a$ (.92)	2.38 a (1.10)	2.10 a (1.29)	2.977	.14
Textbook	1.62$_a$ (.86)	1.77$_a$ (1.07)	2.50$_a$ (1.21)	2.323	.11

Note. Standard deviations appear in parentheses below means. Means with different subscripts within rows are significantly different at the $p < .05$ based on Fisher's LSD post hoc paired comparisons.
*$p < .05$. **$p < .01$.

For Internet use, there was a statistically significant difference between low-level computer literacy PE teachers and high-level computer literacy PE teachers as determined by one-way ANOVA, $F(2, 54) = 5.351$, $p = .008$. A Fisher's LSD post hoc test revealed that PE teachers showing high computer literacy ($M = 1.70 \pm .82$, $p = .002$) used the Internet in PE statistically significantly more frequently than did PE teachers showing low computer literacy ($M = 1.08 \pm .27$). There were no statistically significant differences between low-level computer literacy PE teachers and high-level computer literacy PE teachers ($p = .072$) and no statistically significant differences between high-level computer literacy PE teachers and high-level computer literacy PE teachers ($p = .099$).

Regarding laptop use in PE, there was a statistically significant difference between low-level computer literacy PE teachers and high-level computer literacy PE teachers and between high-level computer literacy PE teachers and high-level computer literacy PE teachers as determined by one-way ANOVA, $F(2, 54) = 5.566$, $p = .006$. A Fisher's LSD post hoc test revealed that PE teachers showing high computer literacy ($M = 2.00 \pm 1.15$, $p = .002$) used laptops in PE statistically significantly more frequently than did PE teachers showing low computer literacy ($M = 1.14 \pm .48$) and that PE teach-

ers showing high computer literacy ($M = 2.00 \pm 1.15$, $p = .006$) used laptops in PE statistically significantly more frequently than did PE teachers showing average computer literacy ($M = 1.27 \pm .60$). There were no statistically significant differences between low-level computer literacy PE teachers and high-level computer literacy PE teachers ($p = .535$).

Concerning digital camera use in PE, there was a statistically significant difference between low-level computer literacy PE teachers and high-level computer literacy PE teachers and between high-level computer literacy PE teachers and high-level computer literacy PE teachers as determined by one-way ANOVA, $F(2, 54) = 4.747$, $p = .013$. A Fisher's LSD post hoc test revealed that PE teachers showing high computer literacy ($M = 2.70 \pm 1.16$, $p = .003$) used digital cameras in PE statistically significantly more frequently than did PE teachers showing low computer literacy ($M = 1.57 \pm .93$) and PE teachers showing average computer literacy ($M = 1.92 \pm .89$, $p = .033$). There were no statistically significant differences between low-level computer literacy PE teachers and average-level computer literacy PE teachers ($p = .214$).

Discussion

With regard to the findings of Woods et al. (2008), C. Yaman (2008), and M. Yaman (2007b), the data suggest that PE teachers do not show worse or better computer literacy than other school subject teachers (Albirini, 2006; Al-Zaidiyeen, Mei, & Fook, 2010; Y. Goktas, Yildirim, & Yildirim, 2009; Kibirige, 2011; Wastiau et al., 2013). The PE teachers appear to be neither tech savvy nor total ICT beginners. This opposes an understanding of PE as a contradicting entity to sedentary media-heavy leisure and educational settings. Within this PE philosophy, the human body is regarded as only relevant media, and PE teachers therefore may not need to have computer literacy as they are not intended to integrate technology (Kretschmann, 2010, 2012). Nevertheless, the PE teachers, being "digital immigrants" (Prensky, 2001), show sufficient computer literacy levels regardless of whether such a media-neglecting PE philosophy may be assumed. Another common belief among PE teachers that may cause less technology use is that integrating technology leads to a reduction in movement time (Mears, 2009a; Perlman, Forrest, & Pearson, 2012).

The sample covered mostly established PE teachers who had been in service for several years. Therefore, age appears to be a fac-

tor as the majority of the PE teachers may not have been exposed to technology as an instructional method during their school and college level education (Ayers & Housner, 2008; Hetland & Strand, 2010). Older PE teachers may be stigmatized as digital immigrants, whereas younger teachers are most certainly digital natives (Guo, Dobson, & Petrina, 2008). Following this thought, future generations of PE teachers are expected to show higher levels of ICT competency as well as prospective teachers of other school subjects (Mohnsen, 1997). On the other hand, there may be an alternative approach that deliberately promotes PE as a school subject that gives students, who are constantly exposed to technology, a media-absent break that they may experience as a relief (Acquaviva, Beaudet, & Maina, 2013). As the PE teachers' PE philosophy and ideologies were not surveyed, the relationship between the PE teachers' conceptual understanding of PE and technology use in PE remains unclear.

Despite increased interest of PE teachers in technology stated in previous studies (Gibbone, Rukavina, & Silverman, 2010; Perrotta, 2013; Thomas & Stratton, 2006), the PE teachers in this study tended to not include technology in PE. These results mirror the findings by Kretschmann (2012) that reveal a negative and skeptical attitude to integrating technology in PE. Especially, ICT (PC, laptop, and Internet) is hardly used in PE. A decent level of computer literacy and an (assumed) interest in instructional technology seems not to lead to a trend in integrating more technology (and instructional media in general) into PE. Compared with a PE teacher sample in Gibbone et al. (2010) who had positive attitudes toward technology use in PE, the sample in this study tended to have negative attitudes toward integrating technology in PE.

Statistically significant gender differences were found in only two of the 15 assessed instructional media. This result confirmed other findings that indicate there is no major gender difference in this subject area (Ilomaki, 2011; Vekiri, 2013).

The gender differences in stereo system use may have been caused by a content preference bias of male and female PE teachers (Green, 2008). It may be assumed that female PE teachers tend to cover more dance and rhythmic gymnastics activities in PE than do male PE teachers (Hill & Cleven, 2005). As these activities are usually accompanied by music, female teachers may use stereo systems more frequently. In addition, male teachers may tend to avoid such activities as they may feel uncomfortable with such content (Rustad, 2012).

The gender differences in the use of overhead projectors in PE may have been caused in this study sample because more male PE teachers also taught a natural science subject compared with the female PE teachers. In regard to everyday school practices, it may be assumed that natural science school subject teachers tend to use more visual instructional methods such as overhead projectors than do teachers of other school subjects. A common and established teaching method in a particular subject may therefore be more likely to be used in other subjects taught by the same teacher. However, this is mere speculation and not based on empirical evidence.

In sum, it is not much of a surprise that computer literacy levels in PE teachers influence their actual (digital) instructional technology use, whereas there is no effect on traditional (analogue) instructional media. Common sense may be confirmed by the findings in this study, reporting that the higher the level of PE teachers' computer literacy is, the more likely they will also use instructional technology such as laptops, Internet, and digital cameras in PE.

Statistically significant differences were found between PE teachers' computer literacy levels in regard to instructional technology and media use (ANOVA accompanied by LSD post hoc tests) in only three of 15 instructional media, and this suggests that computer literacy levels do not influence traditional instructional media use, but (portable) ICT use and digital camera use. The statistically nonsignificant varying results for PCs compared with the statistically significant results for laptops may be explained by the laptop being portable. PCs may not be regarded as useful for PE as they are restricted to a single location. In contrast, laptops are portable and can serve in multiple occasions and locations within the PE setting (Juniu, 2011; Kretschmann, 2010; Mohnsen, 2005).

The use of Internet for and in PE has been well documented in the literature (Elliott, Stanec, McCollum, & Stanley, 2007; Leight, 2012; Neal, 2000). The effect of PE teachers' computer literacy on Internet usage rate in and for PE also derives theoretically from the direct connection of Internet and computers/laptops. There is simply no Internet connection possible without a device such as a computer/laptop or handheld with an operating system installed. Moreover, without the necessary computer literacy to use and operate a computer or computer-like device, there will be no access to the Internet. Thus, there was an expected relationship of computer literacy and Internet use based on this explanatory framework.

The influence of the PE teachers' computer literacy level on digital camera use in PE is based on its nature of a human–machine interaction interface and digital storage. The characteristics of these digital cameras are well placed in a computer literacy context as using the operating system on a digital camera may be similar to using an operating system on a computer. Furthermore, several pedagogical scenarios of integrating digital cameras in PE have been provided in the literature (Mikat & Anderson, 2005; Ryan, Marzilli, & Martindale, 2001). As functionalities of digital cameras and video cameras overlap in terms of video capturing, the survey did not include such a distinction. Therefore, it cannot be inferred to which amount the PE teachers used digital cameras for video recordings. In addition, the overlap with smartphone video recording functionalities (Cummiskey, 2011) was not covered in this study.

Only high school level PE teachers participated in this study, and this limits the results. Technology use and related PE philosophies are most likely to be different in school forms and grade levels (Gibbone et al., 2010; Woods et al., 2008). Primary school PE has different structures and principles than secondary school PE (Graham, Holt/Hale, & Parker, 2007), which leads to different technology applications and rationales (LaMaster, Barnes-Wallace, & O'Connor Creeden, 2002; Mitchell, 2001; Sun, 2012).

As mentioned before, it is likely that this study group formed a PE teacher sample who had relatively negative attitudes toward technology use in PE. A PE teacher sample with positive attitudes to PE might lead to different results (Gibbone et al., 2010; Z. Goktas, 2012). Therefore, there might be a study groups' negative bias according to technology use in PE.

The diverse other factors that influence technology use of teachers were not covered in this study. For instance, access to adequate levels of ICT infrastructure cannot be assumed universal among teachers (Burnip, 2006). Especially for PE teachers, it may be difficult to access and transport technology that may be available in the regular classroom to PE facilities. For instance, the mere lack of a power outlet may deem certain technology uses as impossible.

Other factors include parent and community support, availability of vision and plan about contribution of ICT on a particular school's education, availability of time (to experiment, reflect, and interact), available support to computer-using teachers in the workplace, school culture, computer attributes, level and quality of training for teachers and school principals, attitudes to computer,

and effective training program (Afshari et al., 2009; Perrotta, 2013; Prestridge, 2012). This high amount of influencing factors on teachers' technology use in class explains the low effect sizes ($\eta^2 = .06 - .18$) of the ANOVA. However, the enormous number of confounders and related factors clearly emphasizes the complexity beyond the technology use by teachers.

Overall, technology use in PE may not be as numerous in reality opposed to the numerous literature finds (Kretschmann, 2010) and seems to be far away from mandatory or ubiquitous. Nevertheless, pressure on PE teachers to integrate technology may increase as the digital native PE students will probably demand the same technologies that ubiquitously surround them in their daily routines for the school classroom and PE facilities as well, which can already be stated for the higher education classroom setting at least (Kinash, Wood, & Knight, 2013). As the instructional technology will likely continue developing, applications for PE will likely do so as well. PE teachers will therefore have plenty of pedagogical uses of technology in PE to experiment on and chances to work on their computer and ICT literacy, too (Woods et al., 2008).

Conclusions

The surveyed high school level in-service PE teachers tended to not use technology and general instructional media in PE. In conclusion, the PE teachers' computer literacy influenced their technology use in PE for (portable) ICTs (laptop, Internet, and digital camera) on a statistically significant level. The higher the PE teachers' computer literacy level was, the more likely they were to integrate the respective technologies in PE.

Future research on the relation between computer literacy and technology use in PE may be focused more on ICT assets such as handhelds, smartphones, and tablets (Cummiskey, 2011; Monsma, 2003; Nye, 2010), podcasts (Nordmeyer & Castelli, 2009; Shumack & Reilly, 2011), wikis (Mears, 2009b), virtual PE (Rhea, 2011), and blended learning scenarios (Vernadakis, Giannousi, & Tsitskari, 2012). The factors influencing teachers' technology use in classes (Afshari et al., 2009) should be integrated into comprehensive study designs to shed more light on their relationships in the PE setting. Practical implications for PETE and PE teachers' continuing education arise as far as that successful programs for the development of computer and ICT literacy should continue to emerge (Bechtel, 2010; Leight & Nichols, 2012), eventually being scientifically evaluated in the process.

References

Acquaviva, J., Beaudet, R., & Maina, M. P. (2013). Technology in physical education: Striking a delicate balance. *The Global Journal of Health and Physical Education Pedagogy, 2*, 197–204.

Adamakis, M., & Zounhia, K. (2013). Greek undergraduate physical education students' basic computer skills. *The Physical Educator, 70*, 135–154.

Afshari, M., Abu Bakar, K., Luan, W. S., Abu Samah, B., & Say Fooi, F. (2009). Afshari factors affecting teachers' use of information and communication technology. *International Journal of Instruction, 2*(1), 77–104.

Albirini, A. (2006). Teachers' attitudes toward information and communication technologies: The case of Syrian EFL teachers. *Computers & Education, 47*, 373–398.

Al-Zaidiyeen, N. J., Mei, L. L., & Fook, F. S. (2010). Teachers' attitudes and levels of technology use in classrooms: The case of Jordan schools. *International Education Studies, 3*, 211–218.

Ayers, S. F., & Housner, L. D. (2008). A descriptive analysis of undergraduate PETE programs. *Journal of Teaching in Physical Education, 27*(1), 51–67.

Bechtel, P. A. (2010). Technology utilization: Thread it through the PETE curriculum. *Journal of Physical Education, Recreation, & Dance, 8*(6), 53–56.

Bennett, S., Maton, K., & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology, 39*(5), 775–786.

Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature. *International Journal of Education and Development Using Information and Communication Technology, 8*(1), 136–155.

Burnip, L. (2006). ICT mediated study and teachers: Do they have access to the infrastructure? *Australasian Journal of Educational Technology, 22*(3), 355–374.

Calvani, A. (2009). ICT in schools: What rationale? A conceptual frame for a technological policy. *Educational Technology, 49*(4), 33–37.

Cummiskey, M. (2011). There's an app for that: Smartphone use in health and physical education. *Journal of Physical Education, Recreation, & Dance, 82*(8), 24–29.

Elliott, S., Stanec, A. S., McCollum, S., & Stanley, M. A. (2007). Uses of the internet by health and physical education teachers. *Strategies: A Journal for Physical and Sport Educators, 20*(5), 19–27.

Gibbone, A., Rukavina, P., & Silverman, S. (2010). Technology integration in secondary physical education: Teachers' attitudes and practice. *Journal of Educational Technology Development and Exchange, 3*(1), 27–42.

Goktas, Y., Yildirim, Z., & Yildirim, S. (2009). Investigation of K–12 teachers' ICT competences and the contributing factors in acquiring these competences. *The New Educational Review, 17*(1), 276–294.

Goktas, Z. (2012). The attitudes of physical education and sport students towards information and communication technologies. *TechTrends: Linking Research and Practice to Improve Learning, 56*(2), 22–30.

Graham, G. M., Holt/Hale, S. A., & Parker, M. A. (2007). *Children moving: A reflective approach to teaching physical education* (8th ed.). New York, NY: McGraw-Hill.

Green, K. (2008). *Understanding physical education*. London, England: Sage.

Guo, R. X., Dobson, T., & Petrina, S. (2008). Digital natives, digital immigrants: An analysis of age and ICT competency in teacher education. *Journal of Educational Computing Research, 38*(3), 235–254.

Hetland, K. M., & Strand, B. (2010). A descriptive analysis of undergraduate PETE programs in the central district. *ICHPER-SD Journal of Research, 5*(1), 3–9.

Hill, G., & Cleven, B. (2005). A comparison of 9th grade male and female physical education activities preferences and support for coeducational groupings. *The Physical Educator, 62*(4), 187–197.

Horst, H. A. (2012). New media technologies in everyday life. In H. A. Horst & D. Miller (Eds.), *Digital anthroplogy* (pp. 61–79). London, England: Berg.

Ilomaki, L. (2011). Does gender have a role in ICT among Finnish teachers and students? *Scandinavian Journal of Educational Research, 55*(3), 325–340.

Juniu, S. (2011). Pedagogical uses of technology in physical education. *Journal of Physical Education, Recreation, & Dance, 82*(9), 41–49.

Kibirige, I. (2011). In-service science teachers' attitude towards information communication technology. *South African Journal of Higher Education, 25*, 1513–1525.

Kinash, S., Wood, K., & Knight, D. (2013). Digital immigrant teachers and digital native students: What happens to teaching. *Education Technology Solutions, 54*, 56–58.

Kreijns, K., Vermeulen, M., Kirschner, P. A., Van Buuren, H., & Van Acker, F. (2013). Adopting the integrative model of behaviour prediction to explain teachers' willingness to use ICT: A perspective for research on teachers' ICT usage in pedagogical practices. *Technology, Pedagogy, and Education, 22*(1), 55–71.

Kretschmann, R. (2010). Physical education 2.0. In M. Ebner & M. Schiefner (Eds.), *Looking toward the future of technology-enhanced education: Ubiquitous learning and the digital native* (pp. 432–454). Hershey, PA: IGI Publishing.

Kretschmann, R. (2012). What do physical education teachers think about integrating technology in physical education? *European Journal of Social Sciences, 27*(3), 444–448.

LaMaster, K., Barnes-Wallace, L., & O'connor Creeden, K. (2002). Using technology in elementary physical education. *Journal of Physical Education, Recreation, & Dance, 73*(8), 12–13.

Leight, J. (2012). *Technology for physical education teacher education: Student handbook of technology skills instruction and assessment*. Publisher: Author.

Leight, J., & Nichols, R. (2012). Infusing technology into a physical education teacher education program. In D. Polly, C. Mims, & C. Persichitte (Eds.), *Developing technology-rich teacher education programs: Key issues* (pp. 422–436). Hershey, PA: Information Science Reference.

Levent Ince, M., Goodway, J. D., Ward, P., & Lee, M.-A. (2006). Chapter 6: The effects of professional development on technological competency and the attitudes urban physical education teachers have toward using technology. *Journal of Teaching in Physical Education, 25*(4), 428–440.

Mears, D. (2009a). Technology in physical education: Article #1 in a 6-part series: Becoming tech savvy! *Strategies: A Journal for Physical and Sport Educators, 22*(4), 30–32.

Mears, D. (2009b). Technology in physical education: Article #4 in a 6-part series: Podcasts and wiki's: Delivering content information to students using technology. *Strategies: A Journal for Physical and Sport Educators, 23*(1), 29–34.

Mikat, R. P., & Anderson, M. (2005). Choosing the best digital camera for your program. *Journal of Physical Education, Recreation, & Dance, 76*(3), 20–21.

Mitchell, M. S. (2001). Using technology in elementary physical education. *Strategies: A Journal for Physical and Sport Educators, 14*(6), 28–31.

Mohnsen, B. S. (1997). Stretching bodies and minds through technology. *Educational Leadership, 55*(3), 46–48.

Mohnsen, B. S. (2005). Notebooks, handhelds, and software in physical education (Grades 5–8). *Teaching Elementary Physical Education, 16*(5), 18–21.

Mohnsen, B. S. (2012). *Using technology in physical education* (8th ed.). Big Bear Lake, CA: Bonnie's Fitware.

Monsma, E. V. (2003). Using handheld technology for observational assessment in elementary physical education. *Teaching Elementary Physical Education, 14*(4), 35–37.

National Association for Sport and Physical Education. (2009). *Appropriate use of instructional technology in physical education* [Position statement]. Reston, VA: Author.

Neal, N. D. (2000). Using internet technology in physical education and dance. *Strategies: A Journal for Physical and Sport Educators, 13*(3), 26–28.

Nemcek, F. (2013). A progressive approach to integrating education technology. *Techniques: Connecting Education and Careers, 88*(1), 32–35.

Newell, K. M. (2011). Physical education "of" and "through" fitness and skill. *Quest, 63*(1), 46–54.

Nordmeyer, E., & Castelli, D. M. (2009). Podcasting and motivation in physical education. *Research Quarterly for Exercise and Sport, 80*(1), A-68.

Nye, S. B. (2010). Tablet PCs: A physical educator's new clipboard. *Strategies: A Journal for Physical and Sport Educators, 23*(4), 21–23.

Perlman, D., Forrest, G., & Pearson, P. (2012). Nintendo Wii: Opportunities to put the education back into physical education. *Australian Journal of Teacher Education, 27*(7), 85–94.

Perrotta, C. (2013). Do school-level factors influence the educational benefits of digital technology? A critical analysis of teachers' perceptions. *British Journal of Educational Technology, 44*(2), 314–327. doi:10.1111/j.1467-8535.2012.01304.x

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On The Horizon, 9*(5), 1–6.

Prestridge, S. (2012). The beliefs behind the teacher that influences their ICT practices. *Computers & Education, 58*(1), 449–458.

Rhea, D. J. (2011). Virtual physical education in the K–12 setting. *Journal of Physical Education, Recreation, & Dance, 82*(1), 5–6, 50.

Rustad, H. (2012). Dance in physical education: Experiences in dance as described by physical education student teachers. *Nordic Journal of Dance, 3*(1), 15–29.

Ryan, S., Marzilli, S., & Martindale, T. (2001). Using digital cameras to assess motor learning. *Journal of Physical Education, Recreation, & Dance, 72*(8), 13–16.

Shumack, K. A., & Reilly, E. (2011). Video podcasting in physical education. *Journal of Physical Education, Recreation, & Dance, 82*(1), 39–43.

Sun, H. (2012). Exergaming impact on physical activity and interest in elementary school children. *Research Quarterly for Exercise and Sport, 83*(2), 212–220.

Tearle, P., & Golder, G. (2008). The use of ICT in the teaching and learning of physical education in compulsory education: How do we prepare the workforce of the future? *European Journal of Teacher Education, 31*(1), 55–72.

Thomas, A., & Stratton, G. (2006). What we are really doing with ICT in physical education: A national audit of equipment, use, teacher attitudes, support, and training. *British Journal of Educational Psychology, 37*(4), 617–632.

Tinning, R. (2011). *Pedagogy and human movement: Theory, practice, research* (Routledge Studies in Physical Education and Youth Sport). Florence, KY: Routledge, Taylor, & Francis.

Vekiri, I. (2013). Users and experts: Greek primary teachers' views about boys, girls, ICTs and computing. *Technology, Pedagogy, and Education, 22*(1), 73–87.

Vernadakis, N., Giannousi, M., & Tsitskari, E. (2012). A comparison of student satisfaction between traditional and blended technology course offerings in physical education. *The Turkish Online Journal of Distance Education, 13*(1), 137–147.

Wastiau, P., Blamire, R., Kearney, C., Quittre, V., Van De Gaer, E., & Monseur, C. (2013). The use of ICT in education: A survey of schools in Europe. *European Journal of Education, 48*(1), 11–17.

Woods, M. L., Goc Karp, G., Miao, H., & Perlman, D. (2008). Physical educators' technology competencies and usage. *The Physical Educator, 65*, 82–99.

Yaman, M. (2007a). The attitudes of the physical education students towards Internet. *The Turkish Online Journal of Educational Technology, 6*(4), 79–87.

Yaman, M. (2007b). The competence of physical education teachers in computer use. *The Turkish Online Journal of Educational Technology, 6*(4), 46–55.

Yaman, C. (2008). The abilities of physical education teachers in educational technologies and multimedia. *The Turkish Online Journal of Educational Technology, 7*(2), 20–31.