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Predictive Power of Prospective Physical Education Teachers' Attitudes towards Educational Technologies for Their Technological Pedagogical Content Knowledge

Yaprak Kalemoğlu Varol*
Aksaray University

Abstract
The aim of the research is to determine the predictive power of prospective physical education teachers' attitudes towards educational technologies for their technological pedagogical content knowledge. In this study, a relational research model was used on a study group that consisted of 529 (M_{age}=21.49, SD=1.44) prospective physical education teachers. As a data collection tool, a "technology attitude scale" and a "technological pedagogical content knowledge scale" were used. Regarding analyses, inferential statistics as correlation and regression analyses were used, in addition to descriptive analyses. At the end of the research period, it was observed that attitudes towards educational technologies had a high-level effect on technological pedagogical content knowledge, and the variables that constituted a sub-dimension of the attitude scale for educational technologies explained 31% of the total variance in technological pedagogical content knowledge. In addition, it was established that attitudes towards educational technologies and the technological pedagogical content knowledge of prospective physical education teachers were at a high level.

Keywords: technological pedagogical content knowledge; attitude toward educational technology; prospective physical education teacher

***** Yaprak Kalemoğlu Varol is an Assistant Professor at Aksaray University Department of Physical Education and Sport. She earned her Ph.D. in comparative physical education from the Institute of Education Sciences at Gazi University, Ankara. Her research interests are comparative study between the fields of education, educational technology, training programs, teacher training, anxiety and attitudes are included.

Correspondence: yaprak81@gmail.com

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Introduction

Education is a subject that is highly emphasised in the progress of societies and powerful in the formation of countries' futures. At this point, the education field is one of the most important fields where technologies are used in the development of societies' futures. In developed countries, most notably, societies make an effort to educate their citizens using technology. According to Erdemir, Bakırcı and Eyduran (2009), many educators, teachers and researchers see technology as part of a high-quality education; therefore, the importance of technology integration in schools has increased. In this respect, technology integration has become a necessity in education (Liao, 2007).

Technology integration in education is a complicated process that involves many elements (Britten & Cassady, 2005; Eryaman, 2006; 2007). Pedagogical knowledge (PK), field information and technological information are inseparable parts of this process. PK is the knowledge of teachers regarding processes, applications, teaching methods and learning (e.g. knowledge about how to use different teaching styles). Content knowledge (CK) is knowledge about subject areas that teachers must learn (e.g. knowledge about anatomy, biomechanics and gymnastics). Technological knowledge (TK) is knowledge about standard technologies, including books, chalk and blackboards, and developed technologies, including the Internet and digital video (e.g. knowing how to use digital tools). These three knowledge bases (PK, CK and TK) form the core of the Technological Pedagogical Content Knowledge (TPACK) framework (Baert & Stewart, 2014; Koehler & Mishra, 2008; Mishra & Koehler, 2006).

TPACK is identified as a knowledge type that exists when technological knowledge is incorporated into pedagogical content knowledge (PCK), a notion developed by Shulman (1986), in the region where TK, PK and subject area knowledge coincide and interact with these three knowledge types (Mishra & Koehler, 2006; Koehler, Mishra & Yahya, 2007; Niess, 2005). According to Mishra and Koehler (2006), TPACK is an important knowledge type that is different from subject area knowledge, which belongs to the discipline of a field expert, TK, belonging to technology experts, and PK, belonging to a teacher. This analysis goes beyond the three components of content, pedagogy and technology (Fig. 1) (e.g. knowledge about how to use video analysis apps to assess students' movements in physical education). Technological content knowledge, identified in Fig. 1, is the use of suitable technologies for a field that will be taught (e.g. knowledge about using fitness apps to track progress). Technological pedagogical knowledge (TPK) knows how to achieve better results using different technologies in education (e.g. the notion of using Excel to manage attendance). Pedagogical content knowledge (PCK), proposed by Shulman (1987), involves content knowledge that deals with the teaching process (e.g. knowledge of using command styles when teaching dance).

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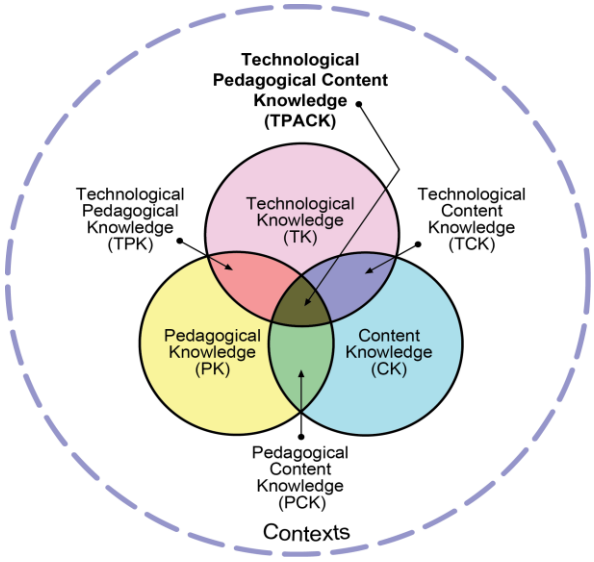

Figure 1. The TPACK Framework (Image from http://tpack.org).

In a period known for knowledge and communication technologies, teachers should be technologically literate and they should use the technological knowledge they have in class applications both meaningfully and responsively (Mishra & Koehler, 2006; Schmidt & Diğerleri, 2009; Valanides & Angeli, 2008). The International Society for Technology in Education (ISTE), an institution in the educational technology field, has identified technology literacy standards and performance indicators for teachers, and it has determined that prospective teachers should adopt these standards. To grow as individuals that seek and use knowledge, teachers should use technological tools effectively and employ technological skills. From this perspective, it is thought that the TPACK model can present teachers and prospective teachers with a deeper perspective about the integration of technology into the teaching process.

In the researches conducted about TPACK, the profiles of teachers and prospective teachers were analysed (Koh, Chai & Tsai, 2010) for their levels of competences regarding TPK (Archambault & Crippen, 2009; Baert & Stewart, 2014; Kwon, 2013; Semiz & İnce, 2012), and their applications of TPACK competences were established (Harris & Hofer, 2011). In addition, it was determined that offering pre-service and in-service career development activities to teachers and prospective teachers had an important effect, generally, on the development of their TPK (Cengiz, 2014; Guzey & Roehrig, 2009; Jang, 2010; Richardson, 2009). When studies conducted on TPACK are analysed, it is observed that research groups are great in number when it comes to mathematics and sciences, generally. Studies about physical education, however, are limited (Baert & Stewart, 2014; Cengiz, 2014; Semiz & İnce, 2012), and they have been performed only over the last two years. However, as with all other education fields, using technology is very important in teaching physical education to provide total support for the lessons. It is thought that the use of technology by teachers in learning environments will increase the success of students. Thus, the National Association for Sport and Physical Education (NASPE) has maintained that technology, when used correctly, is a useful tool that completes the education experience (2004). In addition, researchers have identified different instructional-, sport- and physical education-related technologies that can enhance the benefits of teaching physical education (Roblyer & Doering, 2005). However, wireless technology, computer projection systems and physical activity observation instruments have allowed technology to move into the sports arenas of schools. Technology has gained a new dimension for physical education with the latest developments in games, such as ‘exergaming’, video

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games that incorporate the use of physical activities (Thompson, 2008). Nowadays, with a simple tablet PC and projector, numerous advantages can be realised in a physical education lesson. For example, teachers can use video analysis programs, they can provide feedback to students with videos and photos or they can take notes regarding the performances of students. Therefore, TPACK has become more important to physical education teachers in recent years.

However, as well as having competences regarding TPACK and providing opportunities to use technology more efficiently and actively, the perspectives and attitudes of prospective teachers and teachers regarding technology are very important. In this case, the necessity for knowing the attitudes and ideas regarding the technological instruments that teachers will use in the teaching–learning process grows. Thus, as Christanse (2002) and McGrail (2005) have stated, the attitudes and self-confidences of newly working teachers regarding technology use play important roles in whether they use technology in the learning environment as well as, in effect, the successes of students. At the same time, recent studies have shown that the effective use of educational technologies depends largely on the attitudes of the teachers. A study conducted by Bullock (2004) demonstrated that teachers' attitudes are key enabling or disabling factors in the adoption of technology. In the same way, Kersaint, Horton, Stohl and Garofalo (2003) found that teachers who have positive attitudes towards technology feel more comfortable with using it and usually incorporate it into their teaching. From these results, when it is considered that the years between the ages of 12 and 30 are important in the formation and development of attitudes (Morgan, 2000), it can be said that the years that include the university education of prospective teachers have great importance in almost all countries. It is thought that the positive attitudes of prospective teachers towards using technology developed during these years will lead to more willingness to use technology in education and in further professional life. When this information is considered, it is thought that attitudes towards technology in education may have an important effect on TPACK. When there is such an effect, it is important to demonstrate the benefits of using technology in education to prospective teachers and to resolve to use these technological tools instead of only focusing on gaining TPACK at universities.

When studies conducted about attitudes towards technology in education were analysed, it was observed that using technological instruments in education affected the attitudes of students positively (Yavuz & Çoskun, 2008). In another study, it was established that there was a positive relationship between attitudes towards computers and attitudes towards the educational technologies of prospective teachers (Teo, 2008). In a study conducted by Kalemoğlu-Varol (2014), a positive relationship between attitudes towards educational technologies and computer self-competence beliefs was observed. In addition, it was observed that attitudes towards educational technologies had a medium-level effect on computer self-competence beliefs, and attitudes towards technology explained 11% of the total variance in computer self-competence beliefs. The studies conducted by Yılmaz et al (2010) identified the attitudes of prospective physical education teachers towards technology; it was observed that positive attitudes towards technological instrument usage in the educational activities of students increased as a result of project studies supported by technology. In other words, it was understood that project studies supported by technology developed positive attitudes in students regarding technology. In some studies, it was observed that teachers had positive attitudes towards using technology in education (Albirini, 2006; Enayati, Modanloo & Kazemi, 2012).

When studies conducted on the use of technology in education were analysed, none supported any analyses of the effects of attitudes towards using technology in education on TPACK. In fact, as Rikard and Banville (2006) have stated, attitudes form the behaviours of humans, determine their participation in activities and operationalise individuals. If a physical education teacher that has TPACK does not have a positive attitude towards using technology in education, he or she may not to want to, or cannot, realise this competence. For this reason, it is observed that knowing the effects on existing hardware as well as

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the studies about teachers' technological pedagogical hardware may provide benefits. In this respect, this study aimed to analyse the effects of the attitudes of prospective physical education teachers towards using technology in education on TPACK.

Methods

Study Model

A relational research model was used in this study to identify the relationship between two or more variables and to gain insight into cause–effect relationships (Karasar, 2014). The research aimed to establish a regression level of the technological pedagogical education knowledge of physical education teachers and their attitudes towards using technology in education; therefore, the attitudes of prospective physical education teachers towards using technology and their technological pedagogical education knowledge levels were established.

Participants and Procedure

Teacher candidates at four different universities (Aksaray University, Niğde University, Karamanoğlu Mehmet Bey University and Erciyes University) during the 2013-2014 academic year, as selected using a random sampling method, constituted the study group. The author implemented both scales, and information was given to the students regarding the purposes of the items and the instructions for how to use them. It took approximately 20 minutes for the students to complete the items, including instruction and collection. Out of the 542 completed items, 529 were viable, but the other 13 were missing responses. Furthermore, 222 (42%) of 529 teacher candidates (M_{age}=21.49, *SD*=1.44) were female and 307 (58%) were male ($N_{year\text{-}3}$=*311;* $N_{year\text{-}4}$=*218*).

The Physical Education Teacher Education Program in Turkey

A common program prepared by higher education institutions and that is compulsory in all universities is used in the institutions that educate physical education teachers in Turkey. According to this program, a period of study consists of 8 terms (4 academic years). In this program, the lessons about educational technologies include the "Computer I" and "Computer II" class taken in the year 2 and the "Instructional Technology and Material Design" class taken in the year 3. For this reason, the study group is chosen from prospective teachers in years 3 and 4 for the study to achieve the most effective results and to realise the aim fully.

Data-collection Tools

Data was collected from our participants through a 'technology attitude scale' and a 'technological pedagogical content knowledge scale'.

Technology Attitude Scale

The scale, which was developed by Yavuz (2005), constitutes five factors, including 'not using technological tools in education'; 'using technological tools in education'; 'the effects of technology on educational life'; 'teaching how to use technological tools' and 'evaluating technological tools'. The scale consisted of 19 items, 6 of which were negative and 13 of which were positive. The Cronbach's alpha value was calculated as .87 for the whole scale, and items estimated in the scale's total correlations for item discrimination and item difficulty changed between .24–.68. The scale is a 5-point Likert-type scale that uses the following measurements: (1) I definitely disagree; (2) I disagree; (3) I am neutral; (4) I agree

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and (5) I definitely agree. The positive items of the scale started with "I definitely agree" and continued with 5, 4, 3, 2, and 1; the negative expressions started with "I definitely disagree" and continued with 5, 4, 3, 2, and 1. At the end of the internal-consistency analysis performed in this study, the Cronbach's alpha value was calculated as .88 for the whole scale.

Technological Pedagogical Content Knowledge (TPACK) Scale

This scale, developed by Kabakci-Yurdakul, Odabasi, Kilicer, Coklar, Birinci and Kurt (2012), consists of 33 items and 4 factors, including design, exertion, ethics and proficiency. All items that exist on the scale consist of positive statements. Items on the scale are set up using a 5-point Likert-type scale, including (5) I can do easily; (4) I can do; (3) I can do partly; (2) I cannot do and (1) I certainly cannot do. The Cronbach's alpha coefficient for the whole scale was found to be .95, whereas the values of the Cronbach's alpha coefficients for the individual factors of the scale ranged between .85 and .92. A confirmatory factor analysis was conducted within the scope of a valid study of the scale. In this way, the structure of the 4-factor scale was confirmed. In addition, the test–retest reliability coefficient of the scale was calculated as .80. The lowest score that will be taken from the scale is 33, and the highest score is 165. When scores calculated from the scale approach 165, the technological pedagogical competence increases, and when it approaches 33, the technological pedagogical competence decreases. After the internal-consistency analysis was performed in this study, the Cronbach's alpha values were calculated as .97 for the whole scale, .93 for the design scale, .92 for the exertion scale, .93 for the ethics scale and .89 for the proficiency scale.

Data Analysis

Before the analysis of the study data, the distribution was examined. The Lilliefors Kolmogorov–Smirnov test indicated that the study data were in conformity with a normal distribution ($p>.05$). The histogram graphics and normal distribution curve were determined by Skewness (between +1 and -1) and Kurtosis (between +2 and -2), and further analyses were performed accordingly. In the study, the arithmetic means of the items that were included in each sub-scale were calculated and after this calculation, the score was determined for each relevant factor. The analysis was performed via these factor scores. In the analysis of the data, a descriptive analysis (number, per cent, arithmetic mean and standard deviation) was used. The Pearson Moments Multiplication Correlation Coefficient technique was used in order to identify a relationship. Furthermore, a multiple regression analysis was employed with the purpose of determining the predictive power of the independent variables over the dependent variables. In these analyses, each of the attitudes towards technology sub-scale scores was considered as an independent variable and technopedagogical education competency was considered a dependent variable. In the data analysis, the SPSS 18.00 package program was used.

Findings

The arithmetic means and standard deviation values about the attitudes of prospective physical education teachers towards technological pedagogical education knowledge are shown in Table 1.

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Table 1.
Scores of the attitudes towards educational technologies and technological pedagogical education knowledge

Dimension	n	*M*	SD
Technology attitude	529	71.02	11,37
Technopedagogical Education Competency		131,53	23,45

When Table 1 was analysed, it was established that the attitudes of prospective physical education teachers towards educational technologies (*M*=71.02, *SD*=11.37) and their technological education knowledge (*M*=131.53, *SD*=23.45) were at high levels.

The Relationship between Attitudes towards Educational Technologies and Technological Pedagogical Education Knowledge

The analysis results identifying the relationship between attitudes towards educational technologies and technological pedagogical education knowledge are shown in Table 2.

Table 2.
The relationship between attitudes towards educational technologies and technological pedagogical education knowledge

Variables	1	2	3	4	5	6	7	8	9
1. Not using technological tools in education	-								
2. Using technological tools in education	.587**	-							
3. Effects of technology on educational life	.647**	.535**	-						
4. Teaching how to use technological tools	.385**	.558**	.397**	-					
5. Evaluating technological tools	.325**	.592**	.334**	.562**	-				
6. Design	.421**	.490**	.448**	.173**	.116**	-			
7. Exertion	.400**	.433**	.465**	.165**	.246**	.870**	-		
8. Ethics	.187**	.358**	.228**	.002	.037	.879**	.830**	-	
9. Proficiency	.327**	.491**	.252**	.001	.137**	.836**	.788**	.894**	-
Mean	19.58	15.20	14.55	14.60	7.07	39.58	49.04	23.92	19.97
Standard Deviations	3.798	3.191	2.704	3.068	1.851	7.657	7.743	5.308	4.150

**p<0.01

When Table 2 was analysed, it was observed that all of the sub-dimensions of the attitude scales regarding educational technologies correlated positively with all the variables that exist on the TPACK scale.

However, it was observed that the ‘not using technological tools in education’ sub-dimension of the attitude scale regarding educational technologies correlated with design (r=.421, p<.01), exertion (r=.400, p<.01) and proficiency (r=.327; p<.01) at a medium positive level. As well, the ‘effects of technology on educational life’ sub-dimension correlated with design (r=.448, p<.01) and exertion

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(r=.465, p<.01) at a medium positive level. The 'using technological tools in education' sub-dimension correlated with all the variables that exist on the TPACK scale at a medium positive level.

The aim to determine the attitudes of prospective physical education teachers towards educational technologies, the regression levels of their technological educational competences and the results of the analyses are shown in Table 3. In the analyses, each of the sub-factor scores of the attitude scale regarding educational technology was considered an independent variable, and the TPACK scale was considered a dependent variable.

Table 3.
The results of the analysis regarding regression of technological educational competences

Variables	**B**	**Standard Error**	**ß**	**t**	**p**	**Dual r**	**Partial r**
Constant	76.563	5.515		13.882	.000		
Not using technological tools in education	0.304	0.319	0.049	0.951	.342	.370	.042
Using technological tools in education	3.825	0.406	0.521	9.412	.000**	.471	.381
Effects of technology on educational life	1.837	0.431	0.212	4.260	.000**	.396	.183
Teaching how to use technological tools	1.634	0.362	-0.214	-4.516	.000**	.111	-.194
Evaluating technological tools	-1.553	0.612	-0.123	-2.535	.012	.152	-.110
R= 0.552	**R^2**= 0.305						
F= 45.871	**p**= .000						

**p<0.01

When the results in Table 3 were analysed, a regression equation (R^2=.31, F=45.87, p<.01) of the technological pedagogical education competences of the attitude scale regarding the educational technologies' sub-dimensions was important. The variables that constitute the sub-dimensions of the attitude scale regarding educational technologies explain 31% of the total variance in technological pedagogical education competences. According to the standardised regression coefficient (**ß)**, the relative order of importance of the predictor variables of technological pedagogical education competence is: 'using technological tools in education'; 'teaching how to use technological tools'; 'effects of technology on educational life'; 'evaluating technological tools' and 'not using technological tools in education'.

When the results of a t-test on the meaningfulness of the regression coefficients were analysed, it was observed that the 'using technological tools in education'; 'effects of technology on educational life' and 'teaching how to use technological tools' sub-dimensions were meaningful predictors of technological pedagogical education competence.

Discussion and Conclusion

According to the findings obtained through the research, the attitudes of prospective physical education teachers towards education technology were at a good level (Table 1). This finding demonstrates a parallelism with some studies in which the attitudes towards education technology were determined (Albirini, 2006; Arslan, 2008; Basarici & Ural, 2009; Enayati et al, 2012; Yavuz & Coskun, 2008; Yılmaz et al, 2010). According to the other findings obtained from the research, prospective physical education teachers use technological pedagogical education knowledge at a good level (Table 1). These findings demonstrate parallelisms with the findings of studies performed on prospective physical education teachers by Semiz and İnce (2012) and Baert and Stewart (2014). In a study conducted by Koh, Chai and Tsai (2010), the TPACK levels of prospective teachers were found to be better than average.

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When the relationship between the attitudes towards educational technologies and technological pedagogical education knowledge was analysed in the research (Table 2), it was established that all the sub-dimensions of the attitude scale regarding educational technologies correlated positively with all the variables that exist on the technological pedagogical education knowledge scale. Therefore, it can be argued that a positive increase in the attitudes towards technology may affect technological pedagogical education knowledge positively. No studies support this finding, so the results cannot be interpreted through comparisons with other research findings. However, when the attitudes that form human behaviour, determine their participation in activities and operationalise individuals are considered (Rikard & Banville, 2006), the findings obtained may be as expected. Thus, as Christanse (2002) and McGrail (2005) have stated, when prospective teachers start to work, their attitudes towards using technology play an important role in whether they use technology in the education environment. Recent studies have shown that the successful use of educational technologies depends largely on the attitudes of teachers. Bullock (2004) revealed that teachers' attitudes are significant enabling or disabling factors in the adoption of technology. In another study, Kersaint, Horton, Stohl and Garofalo (2003) found that teachers who have positive attitudes towards technology feel more comfortable with using it and usually incorporate it into their teaching.

In the research, it was determined that the sub-dimensions of the attitude scale regarding educational technologies had a high-level effect on technological pedagogical education knowledge (Table 3). In addition, the effects of attitudes towards educational technologies on technological pedagogical education knowledge were explained at a rate of 31%. In the research, it was observed that a positive increase in attitudes towards educational technologies had an important effect on increases in technological pedagogical education knowledge. In researching factors that affect attitudes towards educational technologies, concrete suggestions can be made to improve technological pedagogical education knowledge. However, it was observed that using technological tools in educational environments affected students' attitudes positively and students had positive interpretations of the use of technology (Yavuz & Çoskun, 2008). In a study conducted on prospective physical education teachers, as a result of the project studies supported by technology, it was determined that the positive attitudes of students regarding the use of technological tools in their educational activities increased. In other words, it was observed that project studies supported by technology developed positive student attitudes towards technology (Yılmaz, Ulucan & Pehlivan, 2010). In another study, a relationship between prospective teachers' attitudes towards computers and their attitudes towards educational technologies was established (Teo, 2008). In a study conducted by Kalemoğlu-Varol (2014), a positive relationship was established between attitudes towards educational technologies and computer self-competence beliefs. It was established that attitudes towards educational technologies had a medium-level effect on computer self-competence beliefs, and attitudes towards technology explained 11% of the total variance in computer self-competence beliefs.

It is thought that the attitudes of individuals may reflect behaviours over time; therefore, it is thought that prospective teachers will develop positive attitudes towards using technology during their university years, encouraging them to use these technologies in their future professional life more actively and more efficiently. For this reason, the benefits of using technological tools in education during these years and encouraging the use of these technological tools will be expressed. In addition, when instructors realise the benefits of technological tools in the education process in universities, prospective teachers may experience positive effects.

There are some limitations in this study. It makes it harder to generalize the results of this study, because it has been conducted in only four universities, and the study group has been relatively small. This is the first study conducted to determine the predictive powers of prospective teachers' attitudes towards educational technologies for their technological pedagogical knowledge. Therefore, it is thought

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that it will lead further studies to be conducted in the future in this field. For this reason, there is a need for similar field studies that can be conducted using different samples. In addition, it is thought that this type of study will be useful in explaining better the attitudes of prospective physical education teachers towards educational technologies and their technological pedagogical education knowledge.

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