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Turkish Physical Education Teachers' Use of Technology: Application and Diffusion of Technological Innovations

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Abstract: The purpose of this study was to determine Turkish physical education (PE) teachers' level of technological innovation use and attitudes regarding their applications and diffusion. This study consisted of 678 Turkish PE teachers. In total, 265 (39.1%) of the PE teachers were female, and 413 (60.9%) were male. A sequential explanatory mixed-methods design was used in this study. "The Applying and Diffusing Technological Innovations Scale for Teachers" was used for data collection. The results showed that the main obstacles the PE teachers face in using technological innovations were the cost of products; security and privacy problems; the need for new versions and technical support; the lack of time; the lack of interest; difficulty in accessing technology; and the lack of understanding. Moreover, there was a significant difference in the tendency to apply and diffuse technological innovations in terms of gender, school type, and school level. We found that the "ability to use innovations" sub-dimension affects the PE teachers' tendencies to apply and diffuse technology. As a result, we recommend providing various training programs on technological innovations to the older/longer-serving PE teachers, especially those working in public schools and secondary schools.

Keywords: physical education teacher; technological innovation; diffusion; perception of innovation; individual effects; social effects

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1. Introduction

The world is going through very rapid changes, witnessing the beginning of the Fourth Industrial Revolution, and many new concepts have been developed during the last ten years. Artificial intelligence, robots, sensors, and striking developments in internet technologies and digital platforms are bringing the world to the brink of an unprecedented transformation. An incredible quantity of data, robotic systems, 3D printers, and nanotechnology have come into being with the Fourth Industrial Revolution, and they have raised people's living standards. Therefore, in the post-digital world that has begun to be witnessed in the 21st century, information and communication technologies have gained importance in line with the needs of individuals, and economies driven by these technologies have formed. As a result, technologically oriented innovations in social, cultural, political, and economic fields have also affected the education sector and created systemic transformations, including in physical education (PE).

Considering the learning needs of society, as it evolves from the former information society into the digital new world order of the 21st century, rapid access to information anytime and anywhere and instant learning have gained importance. This means that students should be equipped to use, organize, evaluate, present, and communicate information using their new skills. In this process, both the students and the educators who will train them must acquire these skills. For this reason, the level of the ability of educators to use technology should be extremely high, both inside and outside organizations [1]. Although it is generally thought that educators will have certain functions and responsibilities in providing only information, in reality, educators will have to enter the digital compatibility

process with technological changes and development [2]. On the other hand, it is of great importance that educators are aware that technology is now a necessity for human life, as digital technologies have become an inextricable part of almost every aspect of life today, especially for younger people [3].

Due to the rapidly changing and developing technological innovations, the digital tools used in educational environments have increasingly diversified. These tools can be classified as hardware, software, and environments [4]. The examples of hardware include video projectors, smart boards, or interactive boards, as well as mobile hardware tools. This hardware requires software to become functional. The examples of the software group include PowerPoint, Prezi, Excel, Word, Audacity, WeVideo, Adobe Photoshop, Apple iMovie, and Adobe Premiere. For the network group, examples include e-mail systems (Gmail, Yahoo, and Hotmail) for communication; social media, such as Facebook, Twitter, Skype, YouTube, WhatsApp, Messenger, Zoom meetings, and Instagram; search engines, such as Google, Google Maps, and Google Scholar; and blog formats, such as Blogs, Wikis, WordPress, Dropbox, Google Drive, OneDrive, and Cloud-Based Document Storage. These are the modern and traditional hardware infrastructures necessary for the development of technological education methods.

Because students spend most of their time in school, technology can play an important role in better facilitating and encouraging physical activity [5]. Therefore, PE teachers need to integrate technology and diffuse technological innovation to better facilitate and promote physical activity. This study focused on PE teachers' levels of technological innovation use and attitudes regarding applications and diffusion.

1.1. The Diffusion of Innovation (DOI) Theory

The DOI theory developed by Rogers [6] explains how an idea or product gains momentum and how it spreads throughout a certain population or social system. As a result of this spread, people adopt a new idea, behavior, or product as part of a social system. According to Rogers and Singhal [7], diffusion is "the process by which an innovation is transmitted through certain channels over time between members of a social system". Diffusion occurs when an individual perceives an idea, behavior, or product as new or innovative. The main elements are innovations, communication channels, time, and social systems [4,8]. Different roles address different categories when promoting an innovation: innovators, early adopters, early majority, late majority, and laggards [6].

The diffusion of innovation is affected by the social system. Social and contextual influences direct individuals' intention to adopt or maintain innovations [9]. Many individuals are influenced by their peers in deciding whether to adopt an innovation or not. Peers bring new ideas from remote social networks to innovators. These networks provide locally oriented early adopters access to these innovations. Early adopters act as opinion leaders and show the early majority the advantages of innovations. Owing to peer pressure and economic imperative, the late majority and laggards finally adopt innovations [6]. Khanagha et al. [10] stated that diffusion is a gradual process. The adoption and implementation of contemporary technologies in education have been relatively slow [11].

Rogers [6] identified five stages in the innovation process and the conditions that affect the new idea, product, or practice to be adopted: knowledge (exposure and understanding); persuasion (attitude building); decision (commitment to diffusion); application (use); and approval (reinforcement owing to positive results). Therefore, for teachers to adopt innovative technology, they must try to understand it—to receive education, to be convinced that it will work, to decide to use and diffuse it, to start using it, and to confirm that the technology works for them. Factors such as the propensity for technologies, interests, abilities, economic conditions, and time are effective in applying and adopting innovative technologies among teachers. In addition, increased access to digital technology and technical support, appropriate teacher training, and a supply of the necessary equipment to teachers, students, and the main stakeholders in education are the prerequisites for efficiently adopting technology in education [12].

1.2. Physical Education Teachers' Use of Technology

Recently, many studies have highlighted the significance and prospects of using technology [13]. However, several studies have also highlighted the importance of effective physical practices in technology use and have proposed ideas in this regard [14,15]. There are prospective benefits associated with using technology in promoting physical activity. For example, many scientific studies have been conducted to improve athletes' training and performance [16,17]. These studies pave the way for the production of state-of-the-art tools and systems used in physical education and sports [18]. Particularly with mobile technology, physical educators now have a wide range of tools that they can use to examine and improve their student's physical skills. These tools provide evidence of their positive impact on educational processes; they have supported mobile technology [19], analyzed video tutorials as a teaching tool [20], and showed the impact of video games in physical education [21]. Some studies have also confirmed that technology promotes the development of physical and psychological skills, enhances creativity and personal involvement, and facilitates an individualized pace of learning [22,23]. Physical education teachers need to adapt to these technological developments in the educational environment.

However, some researchers have observed that teacher burnout and resistance to innovation owing to the stress caused by "change" constitute an obstacle to adopting any innovation in education and that mandatorily implementing technology does not lead to high-level adoption [24,25]. At this point, there is a need to understand whether PE teachers have a willingness to apply and diffuse technological innovations. Therefore, the purpose of this study was to understand the current situation regarding Turkish PE teachers' obstacles to using technological innovations and their tendency to apply and diffuse technological innovations.

In this context, our research questions were as follows: Is there any difference in technological innovation use among PE teachers in terms of gender? Is there any difference in the main obstacles faced by PE teachers in using technological innovations in terms of gender? What are the other main obstacles faced by PE teachers in using technological innovations? Is there a difference in the tendency of PE teachers to apply and diffuse technological innovations in terms of school type? Is there a difference in the tendency of PE teachers to apply and diffuse technological innovations in terms of school level? Is there any difference in the tendency of PE teachers to apply and diffuse technological innovations in terms of years of professional service? Do the main obstacles PE teachers face in using technological innovations predict their tendency to apply and diffuse technological innovations?

2. Materials and Methods

2.1. Research Design

This study used a sequential explanatory mixed-methods design to determine the obstacles faced by Turkish PE teachers in using technological innovations and their tendency to apply and diffuse technological innovations. Mixed-methods research is used in the field of health, social, and behavioral sciences, wherein the researcher integrates two sets of data, both quantitative and qualitative, to understand the research problem and then draws conclusions using the advantages of integrating these two sets [26]. The quantitative part of the research was based on the PE teachers' responses to the Applying and Diffusing Technological Innovations Scale for Teachers, and the qualitative part of the research consisted of responses to a question regarding what other obstacles the PE teachers face when using technological innovations.

2.2. Participants and Procedures

The participants were PE teachers working in different regions and provinces during the 2019–2020 spring academic semester in Turkey.

As shown in Table 1, in total, 678 PE teachers voluntarily participated in the study. Of these PE teachers, 265 (39.1%) were female, and 413 (60.9%) were male (Age_{mean} = 40.50 ± 5.8);

315 (45.9%) worked in middle schools, and 363 (54.1%) worked in high schools; 634 (93.9%) worked in state schools; and 44 (6.1%) worked in private schools. Of these PE teachers, 57 (7.1%) had 1–5 years, 168 (22.5%) had 6–10 years, 138 (20.5%) had 11–15 years, 191 (30.2%) had 16–20 years, 124 (9.5%) had 21 years and over of working experience; 577 (90.7%) completed undergraduate education, and 101 (9.3%) completed postgraduate studies.

Table 1. Demographic information of PE teachers.

Variable	Level	Frequency (*n*)	Percent (%)
Gender	Female	265	39.1
	Male	413	60.9
School level	Middle	315	45.9
	High	363	54.1
School type	State	634	93.9
	Private	44	6.1
Professional service years	1–5 years	57	7.1
	6–10 years	168	22.5
	11–15 years	138	20.5
	16–20 years	191	30.2
	21 years and over	124	19.5
Education	Undergraduate	577	90.7
	Postgraduate	101	9.3

The PE teachers were recruited through an explicit sampling procedure [27]. This was convenience sampling, in that any PE teacher who fit the inclusion criteria was included. The university institutional review board approved the study before implementation. The researchers sent an online questionnaire to the PE teachers who wanted to participate via e-mail and social media. In addition to the questionnaire, information was provided about the purpose of the study, the inclusion criteria (working as a PE teacher in a state school), and the participants' right to withdraw with a consent form before data collection. The PE teachers who met the inclusion criteria completed the questionnaire, which included 18 items and an open-ended question. Finally, the data were transferred to the SPSS statistics software package (SPSS 26.0 version).

2.3. Measurement

The tendency of the PE teachers to apply and diffuse technological innovations was evaluated using "The Applying and Diffusing Technological Innovations Scale for Teachers" *(ADTI-S)*. Savery [28] developed a 32-item scale, with 10 multiple-choice questions and 22 4-point Likert-type items. Savery used the roles in the diffusion of innovation (DOI) theory developed by Rogers [6] in developing this survey. Many of the words used by Rogers [6] in the definitions of innovation characterizations (for example, bold, willing, suspicious, and resilient) were included in the survey.

In this study, 21 items used by Savery [28] and 5 items prepared by the researchers were combined. A total of 26 items were formed, and the items were arranged according to the teachers. The scale was a 5-point Likert type and was applied to 468 Turkish PE teachers. As a result of the exploratory factor analysis (n = 268), 18 items were obtained. The scale had four sub-dimensions: individual effects (items 1, 2, 3, 4, 5, 6, and 7), perceptions about innovations (items 8, 9, and 10), social effects (items 11, 12, and 13), and ability to use innovations (items 14, 15, 16, 17, and 18).

As a result of the confirmatory factor analysis (n = 200), the fit values of χ^2 = 385.17, degrees of freedom (df) = 129, n = 200, root mean squared error of approximation (RMSEA) = 0.10,

standardized root mean square residual (SRMR) = 0.08, comparative fit index (CFI) = 0.93, normed fit index (NFI) = 0.89, non-normed fit index (NNFI) = 0.91, and goodness of fit index (GFI) = 0.82 were found to be at the level of good or perfection [29]. Internal consistency coefficients were calculated to determine the scale's reliability. The total Cronbach Alpha coefficient of the four sub-dimensions of the scale was 0.80, that of the first sub-dimension was 0.70, that of the second sub-dimension was 0.73, that of the third sub-dimension was 0.80, and that of the fourth sub-dimension was 0.71. In addition, an open-ended question asked the PE teachers to provide their own opinions regarding the other obstacles they face when using technological innovations.

2.4. Data Analysis

The histogram and distribution charts were examined before using parametric tests in this study. We observed that the curve showed a symmetrical distribution, and the Skewness–Kurtosis values were between −1.5 and +1.5 [30]. Additionally, the homogeneity of the sample was examined with the Levene test according to the school type, school level, and years of professional service, and the *p*-value was found to be higher than 0.05. Descriptive statistics were used for demographic variables. Chi-square analysis was used to compare the PE teachers' use of technological innovations according to gender. Chi-square analysis was used to determine what the main obstacles faced by the PE teachers in using technological innovations were according to gender. Additionally, a *t*-test was used for independent groups to compare the PE teachers' tendencies to apply and diffuse innovative technologies according to school type and school grade variables. Moreover, Analysis of Variance (ANOVA) was used for independent groups to compare the PE teachers' tendency to apply and diffuse innovative technologies according to the professional service year variable, and Tukey's range test was used to determine which groups the difference was between. Finally, multiple linear regression analysis was used to predict whether the main obstacles faced by the PE teachers in using technological innovations predicted their tendency to apply and diffuse them.

In addition, to support quantitative design, inductive content analysis was used for the PE teachers' responses to the open-ended question. The researchers used inductive content analysis and constant comparison [31] to identify the initial categories and emergent themes from the data [27]. Initial categories were discussed among the researchers to explore the similarities and differences between the groups until an agreement about the coding protocol was established and verified. The second cycle of coding employed a thematic analysis. For the inductive content analysis, data coding, theme identification, data organization according to theme codes, and the interpretation of the findings followed. The qualitative data set was coded as "PET 1, PET 2, and PET 3…", where PET 1 means PE teacher 1. Six-page-long answers were obtained from the open-ended question, and 163 coded units were obtained. As a measure of reliability, the consensus between the two researchers was calculated by consensus, as suggested by Miles et al. [32]. The data from the open-ended question were obtained with an 86% consensus.

3. Results

This section includes findings about the Turkish PE teachers' obstacles in using technological innovations and their tendency to apply and diffuse them in terms of gender, school type, school level, and years of professional service.

Table 2 shows that 93.5% of the PE teachers who participated in the study stated that they have accounts such as Facebook, Instagram, and Twitter, and 6.5% did not. No significant difference was found in the comparison according to gender ($\chi^2_{(1)} = 0.004^a$; $p = 0.542$). In total, 93.5% of the PE teachers stated that they have a laptop, tablet, or computer, and 7.5% did not. No significant difference was found in the comparison in terms of gender ($\chi^2_{(1)} = 1.378^a$; $p = 0.153$). In total, 29.2% of the PE teachers stated that they had a personal web account, and 70.8% did not. No significant difference was found in the comparison in terms of gender ($\chi^2_{(1)} = 1.223^a$; $p = 0.154$). In total, 8.4% of the PE teachers

stated that they had a personal blog, and 91.6% did not. No significant difference was found in the comparison in terms of gender ($\chi^2_{(1)} = 0.132^a$; $p = 0.416$). In total, 26.1% of the PE teachers stated that they had a Skype account, and 73.9% did not. No significant difference was found in the comparison in terms of gender ($\chi^2_{(1)} = 0.255^a$; $p = 0.338$). In total, 99.4% of the PE teachers stated that they had a WhatsApp account, and 0.6% did not. In brief, a significant difference was found in the comparison in terms of gender ($\chi^2_{(1)} = 6.271^a$; $p = 0.023$). In total, 97.8% of the PE teachers stated that they had an e-mail account that they actively used, and 2.2% did not. A significant difference was found in the comparison in terms of gender ($\chi^2_{(1)} = 4.901^a$; $p = 0.027$).

Table 2. PE teachers' use of technological innovations in terms of gender.

	Variable	Female	Male	Total	Sd	χ^2	*p*
Has accounts such as Facebook, Instagram, and Twitter	Yes	248 (36.6%)	386 (56.9%)	634 (93.5%)	1	0.004	0.542
	No	17 (38.6%)	27 (61.4%)	44 (6.5%)			
Has a laptop, tablet, or computer	Yes	249 (36.7%)	378 (55.8%)	627 (93.5%)	1	1.378	0.153
	No	16 (2.4%)	35 (5.1%)	51 (7.5%)			
Has a personal web account	Yes	71 (10.5%)	127 (18.7%)	198 (29.2%)	1	1.223	0.154
	No	194 (28.6%)	286 (42.2%)	480 (70.8%)			
Has a personal blog	Yes	21 (3.1%)	36 (5.3%)	57 (8.4%)	1	0.132	0.416
	No	244 (36.0%)	377 (55.6%)	621 (91.6%)			
Has a Skype account	Yes	72 (10.6%)	105 (15.5%)	177 (26.1%)	1	0.255	0.338
	No	193 (28.5%)	308 (44.5%)	501 (73.9%)			
Has a WhatsApp account	Yes	261 (38.5%)	413 (60.9%)	674 (99.4%)	1	6.271	0.023 *
	No	4 (1.5%)	0 (0%)	4 (0.6%)			
Has an actively used mail account	Yes	255 (37.6%)	408 (60.2%)	663 (97.8%)	1	4.901	0.027 *
	No	10 (1.5%)	5 (0.7%)	15 (2.2%)			

* $p < 0.05$; χ^2 = chi-square; Sd = standard deviation.

Table 3 shows that in terms of the main obstacles encountered in using technological innovations, 32.4% (n: 220) of the teachers stated that the technology was expensive; 19% (n: 129) stated that there were security problems; 9.6% (n: 65) stated that there were privacy problems; 15.0% (n: 102) stated that there was a need to follow new versions; 15.6% (n: 106) stated that there was a need for technical support; 0.9% (n: 6) stated that they were under stress; and 7.4% (n: 50) stated that training was necessary to learn. A significant difference was found in the comparison in terms of gender ($\chi^2_{(1)} = 0.27.882$; $p = 0.000$).

Table 3. The main obstacles faced by PE teachers in using technological innovations in terms of gender.

	Variables	Female	Male	Total	Sd	χ^2	*p*
The main obstacles faced by the PE teachers in using technological innovations	Expensive	83 (12.2%)	137 (20.2%)	220 (32.4%)	6	27.882	0.000 *
	Security problems	45 (6.6%)	84 (12.4%)	129 (19%)			
	Privacy problems	15 (2.2%)	50 (7.4%)	65 (9.6%)			
	Need to follow new releases	58 (8.6%)	44 (6.5%)	102 (15.0%)			
	Need for technical support	37 (5.5%)	69 (10.2%)	106 (15.6%)			
	Being under stress	5 (0.7%)	1 (0.1%)	6 (0.9%)			
	Need for training to learn	22 (3.2%)	28 (4.1%)	50 (7.4%)			

* $p < 0.05$; χ^2 = chi-square; Sd = standard deviation.

Additionally, the PE teachers were also asked what other obstacles they faced in using technological innovations, and a content analysis of their answers is provided below. One of the obstacles faced by the PE teachers in using technological innovations was defined as a "time problem" ($n = 132$, 38%). For example, PETs 5 and 139 stated, "*Time is needed to get to know and use technology*"; PET 422 stated, "*There is no time to use the technology from bickering*

with real life, I also think it is not a good idea to be embedded in electronic devices. Moreover, even the daily hustle and bustle prevent us from seeing and noticing what is happening around us, the sky, the sea, the tree, and the people".

Another obstacle expressed by the PE teachers is a "lack of interest in technology" (n = 74; 21.3%). For example, PET 49 stated, "*My students' indifference to technology distracts me from technology too*"; PET 556 stated, "*I do not see it necessary, I only learn what I need*"; PET 173 stated, "*There are many people who think it is necessary*"; PET 342 stated, "*I do not like technology, I think I am a little disabled*"; PET 104 stated, "*I do not need much technology*"; and PET 285 stated, "*I am far from technology*".

Moreover, the PE teachers stated that another obstacle is "difficulty in accessing technology" (n = 38, 11%). For example, PET 98 stated, "*Unfortunately, everyone cannot reach technologies*"; PET 166 stated, "*I cannot find every technology in Turkey*"; PETs 345 and 542 stated, "*I think it is limited domestic production*"; PET 612 stated, "*Technology changes rapidly, we do not keep up with the changes, and we cannot reach*"; PET 428 stated, "*We are not aware of new technologies*"; and PET 650 stated, "*I cannot use new technologies because they are not supported by the institution*".

Finally, the PE teachers stated that another obstacle is the "lack of understanding of its use" (n = 103, 29.7%). For example, PET 51 stated, "*I find the technology too complicated*"; PET 513 stated, "*I do not understand because my foreign language is not good*"; PET 379 stated, "*I am confused by a wide variety of technologies*"; PET 113 stated, "*I think the introduction of some technologies is inadequate, which makes it difficult for me to understand*"; PET 274 stated, "*They are not explanatory enough*"; and PET 467 stated, "*Their usage is not clear*".

Table 4 shows that there is a significant difference in the sub-dimensions of individual effects and the ability to use innovations sub-dimensions regarding the tendency of the PE teachers to apply and diffuse technological innovations in terms of school type ($p < 0.05$). This difference was in favor of private schools in terms of individual effects (M = 27.34 $\pm$ 3.402) and the ability to use innovations (M = 19.54 $\pm$ 2.444). Furthermore, the data indicated that there is a significant difference in the social effects and ability to use innovations sub-dimensions regarding the tendency of the PE teachers to apply and diffuse technological innovations in terms of school level ($p < 0.05$). This difference was in favor of high schools in terms of social effects (M = 11.02 $\pm$ 2.320) and the ability to use innovations (M = 18.40 $\pm$ 3.823).

Table 5 shows that there is a significant difference in the individual effects [F (4,673) = 3.758, $p < 0.05$], perceptions about innovations [F (4,673) = 4.188, $p < 0.05$], and ability to use innovations [F (4,673) = 5.340, $p < 0.05$] sub-dimensions regarding the tendency of the PE teachers to apply and diffuse technological innovations in terms of years of professional service ($p < 0.05$).

Table 6 shows that the prediction equation for the main barriers faced by the PE teachers in using technological innovations regarding their tendency to apply and diffuse technological innovations was significant (R^2 = 0.028, F = 4.856, $p < 0.05$). Analyzing the significance of the regression coefficients showed that the ability to use innovations sub-dimension is a significant predictor of the main barriers the PE teachers face in using technological innovations. In summary, the individual effects, perceptions about innovations, and social effects sub-dimensions were not the significant predictors of the main barriers the PE teachers face in using technological innovations.

Table 4. Comparison of PE teachers' tendencies to apply and diffuse technological innovations in terms of school-type and school-level variables.

Sub-Dimension	School Type	n	$\bar{X}$	Sd	t	*p*
Individual effects	State	634	25.87	4.462	−2.135	0.033 *
	Private	44	27.34	3.402		
Perceptions about innovations	State	634	11.67	1.688	−0.205	0.838
	Private	44	11.72	1.619		
Social effects	State	634	10.74	2.216	−1.669	0.096
	Private	44	11.31	2.031		
Ability to use innovations	State	634	17.95	3.935	−2.640	0.008 *
	Private	44	19.54	2.444		
Sub-dimension	**School level**	**n**	$\overline{\bar{X}}$	**Sd**	**t**	***p***
Individual effects	Middle school	315	25.87	3.932	−0.535	0.593
	High school	363	26.05	4.797		
Perceptions about innovations	Middle school	315	11.61	1.703	−0.926	0.355
	High school	363	11.73	1.666		
Social effects	Middle school	315	10.49	2.036	−3.133	0.002 *
	High school	363	11.02	2.320		
Ability to use innovations	Middle school	315	17.66	3,902	−2.474	0.014 *
	High school	363	18.40	3.823		

* $p < 0.05$; $\overline{\bar{X}}$ = arithmetic mean; Sd = standard deviation.

Table 5. Comparison of PE teachers' tendencies to apply and diffuse technological innovations in terms of years of professional service.

Sub-Dimension	Professional Service Years	n	$\bar{X}$	Sd	df	F	*p*	Tukey
Individual effects	1–5 years	57	27.54	4.145	4 673 677	3.758	0.005 *	1–5 > 21 years and over
	6–10 years	168	26.31	3.930				
	11–15 years	138	26.21	5.068				
	16–20 years	191	25.57	4.114				
	21 years and over	124	25.12	4.621				
Perceptions about innovations	1–5 years	57	12.38	1.130	4 673 677	4.188	0.002 *	1–5 > 16–20
	6–10 years	168	11.68	1.854				
	11–15 years	138	11.45	1.040				
	16–20 years	191	11.79	1.791				
	21 years and over	124	11.41	1.950				
Ability to use innovations	1–5 years	57	19.03	4.122	4 673 677	5.340	0.000 *	1–5 > 21 years and over
	6–10 years	168	18.58	4.390				
	11–15 years	138	17.94	2.673				
	16–20 years	191	18.23	4.358				
	21 years and over	124	16.77	2.979				

* $p < 0.05$; $\overline{\bar{X}}$ = arithmetic mean; Sd = standard deviation; *df* = degree of freedom; F = variance.

Table 6. Level of prediction of the main obstacles faced by PE teachers in using technological innovations regarding their tendency to apply and diffuse technological innovations.

Sub-Dimensions	β	Standard Error	B	t	*p*
Constant	4.355	0.555		7.850	0.000
Individual effects	−0.012	0.021	−0.029	−0.572	0.568
Perceptions about innovations	0.051	0.050	0.046	1.008	0.314
Social effects	−0.040	0.038	−0.047	−1.052	0.293
Ability to use innovations	−0.070	0.023	−0.143	−3.038	0.002 *
R = 0.167	R^2 = 0.028	F = 4.856	*p* = 0.000 *		

* $p < 0.05$; β = beta; B = a "unit-free" standardized coefficient.

4. Discussion

This study provided information about Turkish PE teachers' use of technological innovations in terms of gender and the main obstacles they face in using technological innovations (trends in applying and diffusing technological innovations in terms of professional service years, school type, and school level). In addition, this study determined the effects of the main obstacles faced by the PE teachers in using technological innovations on their tendency to apply and diffuse technological innovations.

First, we examined the PE teachers' use of technological innovations in terms of gender. Most of the PE teachers included in the research group had accounts such as Facebook, Instagram, and Twitter (*n* = 634). Moreover, they had laptops, tablets, or computers (*n* = 627). In addition, the teachers had WhatsApp accounts (*n* = 674) and stated that they actively used e-mail for communication. (*n* = 663). Therefore, the PE teachers use technological innovations to communicate with others. Furthermore, the data indicated that the PE teachers did not have personal web accounts (*n* = 480), personal blogs (*n* = 621), or Skype accounts (*n* = 501). A significant difference was found in terms of gender regarding having a WhatsApp account and an actively used Gmail account. Additionally, the data indicated that the male PE teachers used WhatsApp and actively used an e-mail account more often. Çuhadar et al. [33] found that pre-service teachers approach technological innovations with skepticism. Therefore, it can be argued that PE teachers adopt some communication tools in terms of gender but others are skeptical.

Second, the PE teachers were asked about the main obstacles they face in using technological innovations in terms of gender. Accordingly, the "expensiveness" of technological innovations (*n*: 220) was the most important obstacle. Afterwards, security problems (*n*: 129) and a need for technical support (*n*: 106) were indicated. Tınmaz and Yakın [34] reported that the main obstacles were the cost of using technological innovations, security problems, privacy issues, and following the new versions of these technologies. On the other hand, Özgür [35] found that the most important factors preventing teachers from using computers in education were an insufficient budget, a lack of hardware, and inadequate in-service training. Gibbone et al. [36] stated that limited budget and a lack of access to appropriate technology are important barriers to PE teachers' adoption of technology. Moreover, Konukman et al. [37] stated that both female and male PE teachers were concerned about the safety of themselves and their students while using technology for learning.

We found a significant difference between the main obstacles the PE teachers face in using technological innovations in terms of gender. The male PE teachers indicated expensive technology, security, and privacy problems; a need for new versions and technical support; and a need for training as greater barriers to using technological innovations than the female PE teachers. On the other hand, the female PE teachers indicated that being under stress in using technology was a greater barrier than others. Accordingly, despite some issues, the male PE teachers feel more confident and competent in using technological innovations than the female teachers. Similarly, Tınmaz and Yakın [34]

found that male university students were more enthusiastic about following technological innovations. Moreover, Juniu et al. [38] found that male prospective PE teachers were more comfortable using technology, and they had more positive attitudes towards technology use. Conversely, Yılmaz et al. [39] observed that female instructors were more successful in individual innovation than male instructors. Tou et al. [40] found that male PE teachers had more positive attitudes towards using digital technology tools than their female colleagues in areas related to innovative and modern teaching.

Moreover, the PE teachers were asked what other obstacles they faced in using technological innovations in this study. The themes were "the time problem, a lack of interest in technology, difficulty in accessing technology, and a lack of understanding its use". Furthermore, several of the PE teachers stated that they do not need technology, have no interest, and are not aware of new technology. In addition, these PE teachers stated that they could not keep up with changes, and they had problems owing to language problems or a lack of comprehensibility. In brief, creating enough time to adopt technological innovations in daily life, being interested in technology, and the accessibility and comprehensibility of technology will make it easier for individuals to spread it. Regarding this point, Tinmaz and Yakın [34] stated that time is an obstacle in using technological innovations in general. Hsua et al. [41] found that the characteristics of being useful, compatible, and observable are the most important factors in innovation adoption. In their theoretical analysis, Maksimovic and Lazic [42] pointed out the need for expanding and developing the digital competencies of physical education teachers. Therefore, it is important to make technology useful, understandable, and easily accessible for PE teachers to adopt and use its innovations.

We examined whether there was a difference in the PE teachers' tendencies to apply and diffuse technological innovations in terms of school type. Accordingly, we determined that there was a significant difference in favor of private schools in the "individual effects and ability to use innovations" sub-dimensions. Personal innovativeness, which includes individuals' willingness to use technological innovations, is one of the key factors for implementing innovation [9]. Corvin [43] stated that technologically innovating schools require enough resources for changes and innovations, and for this, it is important that resources outside the school are well researched and that the school has a large enough workforce to implement freedom and changes.

In the institutionalization policies of private schools, the use of technological innovations for the all-round development of students is at the forefront. In private schools, teachers are encouraged to apply technological innovations up to the highest level and are provided with the necessary training to use them. Therefore, it is expected that the individual effects of the PE teachers working in private schools—such as those due to adopting, following, pioneering, and spreading technological innovations—are more significant than those of the teachers working in public schools. In addition, Loogma et al. [44] found that school management and in-school planning play a major role in increasing educators' understanding of innovation and developing e-learning techniques. Lope Pihie et al. [45] stated that the concept of innovation and change within a school develops depending on its administrative management and that administrative committees have a significant effect on the adoption of new thoughts and ideas by educators. Thus, the administrative policies of private schools have a positive effect on PE teachers' tendency to implement and disseminate technological innovations. However, other studies have emphasized that even if a school administration supports the use of technology in public schools, PE teachers do not prefer to implement technological innovations owing to negative technology use bias or a lack of teaching knowledge on how to use technology in physical education [46].

Furthermore, this study examined whether there is a difference in the PE teachers' tendencies to apply and diffuse technological innovations in terms of school level. Accordingly, we determined that there was a significant difference in favor of high schools in the "social effects and ability to use innovations" sub-dimensions. Therefore, the high school PE teachers influence and encourage each other more in applying and diffusing technological

innovations than the secondary school PE teachers. Kösterelioğlu and Demir [47] found that primary and secondary school teachers cooperate with their colleagues in implementing and disseminating technological innovations and are open to others' experiences. In addition, Könings et al. [48] emphasized that educators should constantly collaborate to develop and make sense of individual innovativeness. Van de Ven [49] stated that the idea of innovation occurs through the exchange of ideas and knowledge transfer between individuals in social life. On the other hand, Eren [50] completed a study with university students and found that social effects were important in adopting technological innovations and mass media, and interpersonal relationships were effective in the spread of technological innovation in a population [9]. Therefore, social interaction among PE teachers is important in the adoption and use of technological innovations. However, Tou et al. [40] found no significant difference in attitudes toward technological tool use among PE teachers at different school levels.

In addition, the study examined whether there was any differentiation in terms of the PE teachers' tendencies to apply and diffuse technological innovations with regard to years of professional service. Accordingly, a significant difference was found in favor of the PE teachers with 1–5 years of professional service in the "individual effects, perceptions about innovations, and ability to use innovations" sub-dimensions. Therefore, effects such as using technological innovations more; being curious; and following, adopting, pioneering, and spreading technological innovations were more in favor of the new PE teachers. Therefore, young and new teachers are more curious about applying and diffusing technological innovations. In particular, Baek et al. [51] found that experienced PE teachers with good PE experience did not think technology played an important role, and they believed that technology was an unnecessary tool for good teaching. In brief, research indicates that the PE teachers with less experience are more likely to accept the use of technological tools in physical education, especially in areas related to computer literacy and equipment [52]. However, there is also research that shows the opposite [40,53].

In the final analysis, this study examined whether the main obstacles faced by the PE teachers in using technological innovations predicted their tendency to apply and diffuse technology. In the estimation equation, the "ability to use innovations" sub-dimension was found to be significant. We found that the "individual effects, perceptions about innovations, and social effects" sub-dimensions are not the significant predictors of the main barriers encountered in using technological innovations. According to this analysis, the teachers' ability to use innovations negatively affects their tendency to apply and diffuse technology. Accordingly, the teachers are inadequate in using new technologies, they are not interested in new technologies, and they do not have experience in using new technologies. PE teachers lack experience in using technological innovations in physical education [52] and may not be familiar with different roles in their implementation [54]. In this context, new technologies should be introduced and guided, and in-service training should be provided via official institutions for PE teachers to use and adopt technological innovations.

5. Conclusions

Especially in today's world, a contemporary education system is needed for teachers to keep up with and benefit from innovations. A teacher in a modern education system should not be afraid of innovations and should aim to carry this train of thought to their students. Our results indicate that PE teachers face some obstacles in using technological innovations. Accordingly, it is important to overcome these barriers, such as expensive technology, security problems, technical support, training in using technology, access to technology, and understanding technology. It is obvious that the barriers faced by PE teachers negatively affect their level of technological innovation use. However, PE teachers should keep students physically active during distance education and gym classes to ensure their socialization and cognitive development. Therefore, they should learn to use the necessary technological tools for this purpose. In summary, providing various training programs on technological innovations for older/longer-serving PE teachers,

especially those working in public schools and middle schools, will increase their interest in technology. This would also reduce the barriers they face. Thus, providing more access to technological innovations in schools with the support of the Ministry of National Education, in-service seminars, and school management support for technological innovations will make it easier for PE teachers to adopt, use, and apply these innovations.

This study was conducted with Turkish PE teachers. Therefore, comparative studies with other teachers in different education branches and different countries should be conducted in the future. Moreover, qualitative studies could be conducted by asking PE teachers for their opinions according to their roles in diffusing technological innovations. Finally, the effects of PE teachers' social networks in applying and diffusing technological innovations could be examined as well.

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