Perceived barriers to adopting information and communication technology in physical education

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Abstract

Background and Study Aim	The use of Information and Communication Technologies (ICTs) in Physical Education (PE) brings the science of sports to life by combining physical and mental activity. It also helps students focus better on practical and theoretical work. The purpose of this study was to investigate the perceived barriers to adopting ICTs in PE lessons among high school teachers in Malaysia.
Material and Methods	A total of 112 Physical Education teachers were selected by stratified random sampling to answer an online questionnaire. Cluster analysis was then conducted to classify PE teachers' profiles according to the frequency scores of experiencing challenges in using ICT tools in PE teaching and learning. Discriminant analyses were performed to determine the significant barriers related to technology that differentiate these clusters.
Results	In conclusion, Cluster analysis identified three well-defined profiles: cluster 1 (excellent degrees in applying ICT to their teaching practices) consists of 44 teachers; cluster 2 (moderate degrees in applying ICT to their teaching practices) consist of 41 teachers; cluster 3 (poor degrees in applying ICT to their teaching practices) consist of 27 teachers. Results revealed seven out of twelve technology-related barriers were significant among these clusters. They are the insufficient number of computers (p<0.001), insufficient number of internet-connected computers (p<0.001), insufficient pedagogical support for teachers (p<0.001), lack of content in the national language (p<0.001), pressure to prepare students for exams and tests (p<0.001), no or unclear benefit to using ICT for teaching (p<0.001) and perception of using ICT in teaching and learning not being a goal in their school (p<0.001).
Conclusions	Awareness of these barriers has implications for physical education, curriculum design, teacher training, and youth participation in the school environment. The positive opinions and attitudes of PE teachers toward ICTs as educational tools could pave the way for improving their digital literacy. Thus increase their rate of use of these tools if they are provided with the appropriate technical resources and training.
Keywords:	information, communication, technology, physical education

Introduction

In the 21st century, educators have access to an almost unlimited number of technological tools to enhance student's learning experiences. Technology can be an educational tool used not only to transform learning but also to foster relationships between students and teachers, close gaps in access to information and support resources, and help meet the needs of individualized learners [1]. Much of the educational technology in use today is accessed through a variety of interactive curricula, programs, apps, and assessment tools available to teachers to enrich their learning experiences in the classroom. Despite the changing role of technology in schools and the emphasis on preparing teacher candidates to master technology, many teachers still feel unprepared to use technology effectively in their classrooms [2]. Therefore, schools should

be confident that teacher preparation programs ensure that new teachers are prepared by higher education institutions to use technology wisely [3]. New teachers leaving a preparation program should not be required to receive remedial instruction from their hiring school or district. Although the need for technology training in teacher education is increasingly discussed, a fundamental problem is the variety and diversity of approaches and strategies used to provide candidates with the knowledge, skills, and readiness to engage with technology as an instructional tool.

To understand the challenge of technology adoption in Physical Education (PE), it is first important to consider the barriers present in the adoption process. A wide range of factors influences teachers' intention to adopt the technology. They include accessibility to technology, support, time to learn, beliefs and values toward technology, training, knowledge, confidence, and skills to operate technology [4]. Besides, PE teachers have

cited limited budget and access to appropriate technology as prominent barriers to technology adoption [5]. Researchers continue to explore the complex factors that influence technology adoption and intention to use. Factors such as perceived usefulness and perceived ease of use embedded in the Technology Acceptance Model 3 (TAM3) [6] have been found to be especially important. Several variables within TAM3 including subjective norms, relevance to work, computer self-efficacy, and perceived enjoyment, appear to influence perceived usefulness and ease of use. For teacher education programs that are in various stages of technology adoption, contextual variables such as administrative support, infrastructure, and funding, as well as faculty development, must be considered and a strategic plan must be created for overcoming potential barriers and obstacles [7]. Given the many variables involved in the use, adoption, and acceptance of technology in a professional context, educators and administrators need to recognize that there is no one-size-fits-all solution or strategy for integrating technology. This is especially true for personal and professional development initiatives.

Much is known about the positive impact of ICT on the teaching/learning process at PE [4, 5, 8]. Numerous empirical work has been conducted to explore how these technological tools can be used as a means for effective and creative teaching. Screen-based technologies, such as computers, tablets, and smartphones, are probably one of the first examples that come to mind when talking about ICT and PE. Teacher education is concerned with how to teach a subject using technology in a pedagogically appropriate way and how to develop the knowledge base for designing and implementing technology-enhanced instruction in physical education [9]. Although the use of ICT in PE has increased globally over the past two decades [8], there remains a data gap on how these technological tools are viewed and used by PE teachers in developing countries. Such data can play a critical role in informing policymakers about opportunities for improvement and technological needs in PE. Therefore, this study aims to identify perceived barriers related to the adoption of technology in PE teaching and learning.

Materials and Methods

Participants.

A total of 112 Physical Education teachers, aged between 25 and 35 years old (M ± SD = 31.9 ± 3.3 years) were selected by stratified random sampling to answer questionnaires on the use of technology in teaching and learning. The sample responded to the statements given and chose their answers based on their perceptions.

Research Design.

Quantitative methodology was used in this study to collect and analyze the data obtained from all the respondents. A questionnaire was self-developed and finalized by the researchers before being distributed to the targeted group of respondents. The questionnaire was designed specifically to address research objectives concerning teachers' perceived barriers to the use of ICT tools in teaching and learning sessions. A self-developed survey questionnaire consisting of two. Section A consists of demographic information of respondents. Meanwhile, Section B comprises 12 items of challenges in using ICT tools in teaching and learning. The questionnaire was based on 5-point Likert Scale ranging from 5 = always, 4 = often, 3 = sometimes, 2 = rarely and 1 = never.

Statistical Analysis.

Cluster analysis (CA) is used to classify PE teachers' profiles according to the frequency scores of experiencing challenges in using ICT tools in PE teaching and learning. CA is a robust method to identify and categorize components or subjects (observations/population) into clusters with a greater homogeneity state within the class and a greater heterogeneity state among classes about a predetermined selection criterion [10]. Ward's technique utilizing Euclidean distances as a degree of resemblance in CA has shown to be very effective

Discriminant analysis is performed to determine the significant barriers related to technology that differentiate three groups (three sampling groups represent excellent, moderate, and low degrees in applying ICT to their teaching practices), which were obtained by Cluster analysis. The DA was put into the raw data using the standard, forward stepwise, and backward stepwise methods [11]. The relative clusters of the PE teachers were treated as dependent variables whereas all the assessed challenges were treated as independent variables.
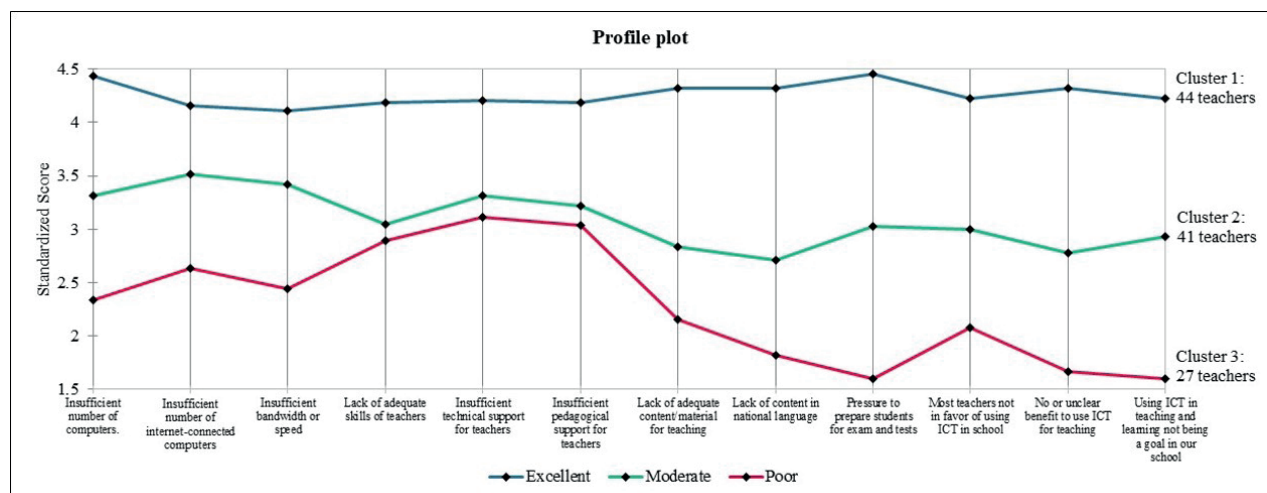
Results

Table 1 shows the frequency of respondents answering questionnaires about challenges in using ICT tools in PE lessons based on their experience at school.

Figure 1 depicts the profile plot of three clusters assigned by Clustering Analysis. A total of 44 PE teachers were assigned to Cluster 1 who experience excellent experience in applying ICT to their teaching practices. This cluster generally agreed they seldom or never experience difficulties when applying technology in their teaching-learning session. Cluster 2 consists of 41 PE teachers who moderately experience difficulties in applying ICT to their teaching practices. Finally, a total of 27 PE teachers were assigned in Cluster 3 who always or often face difficulties in applying ICT to their teaching practices.

Table 2 shows the discriminant analysis

Table 1. Challenges in using ICT tools in PE Teaching & Learning

Items	N=112				
	Always	**Often**	**Sometimes**	**rarely**	**Never**
Insufficient number of computers	0 (0.0%)	24 (21.4%)	33 (29.5%)	28 (25.0%)	27 (24.1%)
Insufficient number of internet-connected computers	0 (0.0%)	16 (14.3%)	41 (36.6%)	32 (28.6%)	23 (20.5%)
Insufficient bandwidth or speed	0 (0.0%)	22 (19.6%)	39 (34.8%)	29 (25.9%)	22 (19.6%)
Lack of adequate skills of teachers	0 (0.0%)	19 (17.0%)	42 (37.5%)	32 (28.6%)	19 (17.0%)
Insufficient technical support for teachers	0 (0.0%)	15 (13.4%)	35 (31.3%)	40 (35.7%)	22 (19.6%)
Insufficient pedagogical support for teachers	0 (0.0%)	16 (14.3%)	34 (30.4%)	46 (41.1%)	16 (14.3%)
Lack of adequate content/material for teaching	6 (5.4%)	26 (23.2%)	35 (31.3%)	24 (21.4%)	21 (18.8%)
Lack of content in the national language	9 (8.0%)	26 (18.8%)	35 (31.3%)	26 (23.2%)	16 (14.3%)
Pressure to prepare students for exams and tests	13 (11.6%)	21 (19.6%)	28 (25.0%)	26 (23.2%)	24 (21.4%)
Most teachers are not in favor of using ICT in school	3 (2.7%)	28 (25.0%)	34 (30.4%)	31 (27.7%)	16 (14.3%)
No or unclear benefit to using ICT for teaching	13 (11.6%)	25 (22.3%)	29 (25.9%)	26 (23.2%)	19 (17.0%)
Using ICT in teaching and learning not being a goal in our school	15 (13.4%)	21 (18.8%)	29 (25.9%)	30 (26.8%)	17 (15.2%)

Figure 1. Groups profile plots of different clusters of the relative perceived barriers of the PE teachers

conducted for further analysis. The DA was applied to clusters defined by HACA to look through variation in relative barriers to technology usage. The clusters act as the dependent variable, whereas perceived barriers parameters were treated as independent variables. Standard, backward stepwise, and forward stepwise mode methods were selected to perform the DA. The precision of classification using standard, backward stepwise, and forward stepwise was 97.32% (12 independent variables), 97.32%

Table 2. Classification matrix of Discriminant Analysis (DA) for the relative barrier variations in the three different clusters of PE teachers.

Mode	Clusters	Excellent	Moderate	Poor	Total	% correctness
	Excellent	43	1	0	44	97.73%
Standard DA	Moderate	0	40	1	41	97.56%
(12 significant barriers)	Poor	0	1	26	27	96.30%
	Total	43	42	27	112	97.32%
	Excellent	44	0	0	44	100.00%
Forward DA	Moderate	0	38	3	41	92.68%
(7 significant barriers)	Poor	0	0	27	27	100.00%
	Total	44	38	30	112	97.32%
	Excellent	44	0	0	44	100.00%
Backward DA	Moderate	0	40	1	41	97.56%
(7 significant barriers)	Poor	0	0	27	27	100.00%
	Total	44	40	28	112	99.11%

Table 3. Unidimensional test of equality of the means of the classes by Discriminant Analysis Backward (stepwise) mode.

Perceived Barriers to Technology	Lambda	F	DF1	DF2	p-value
Insufficient number of computers	0.413	77.466	2	109	<0.0001
Insufficient number of internet-connected computers	0.629	32.205	2	109	<0.0001
Insufficient bandwidth or speed			2	109	n.s.
Lack of adequate skills of teachers			2	109	n.s.
Insufficient technical support for teachers			2	109	n.s.
Insufficient pedagogical support for teachers	0.682	25.402	2	109	<0.0001
Lack of adequate content/material for teaching			2	109	n.s.
Lack of content in the national language	0.227	185.584	2	109	<0.0001
Pressure to prepare students for exams and tests	0.257	157.733	2	109	<0.0001
Most teachers are not in favor of using ICT in school			2	109	n.s.
No or unclear benefit to using ICT for teaching	0.296	129.508	2	109	<0.0001
Using ICT in teaching and learning not being a goal in our school	0.333	109.381	2	109	<0.0001

n.s. = not significant

(seven independent variables), and 99.11% (seven independent variables), respectively.

Table 3 demonstrated seven out of eleven computer-related barriers were significant among excellent, medium, and poor clusters revealed by Discriminant Analysis using Backward stepwise with the highest percentage of classification correctness (99.11%). They include the insufficient number of computers (), insufficient number of internet-connected computers (), insufficient pedagogical support for teachers (), lack of content in the national language (), pressure to prepare students for exams and tests (), no or unclear benefit to using ICT for teaching () and perception of using ICT in teaching and learning not being a goal in their school (). The difference between the three clusters was visualized in Figure 2 below.

Discussion

It is necessary to first consider the barriers that are present in the adoption process to understand the challenge of technology adoption in PE. A wide range of factors has been found to influence teachers' intention to adopt technology [6, 7, 12, 13]. They include accessibility to technology, perceived usefulness, perceived ease of use, subjective norm, facilitating conditions, and attitude towards use. Ensuring appropriate technology bears significance; however, attributing the lack of use of technology to limited resources is a huge challenge today. Undoubtedly, a stronger influencing factor exists among teachers.

Based on the findings, barriers such as an insufficient number of computers and an insufficient number of computers connected to the internet
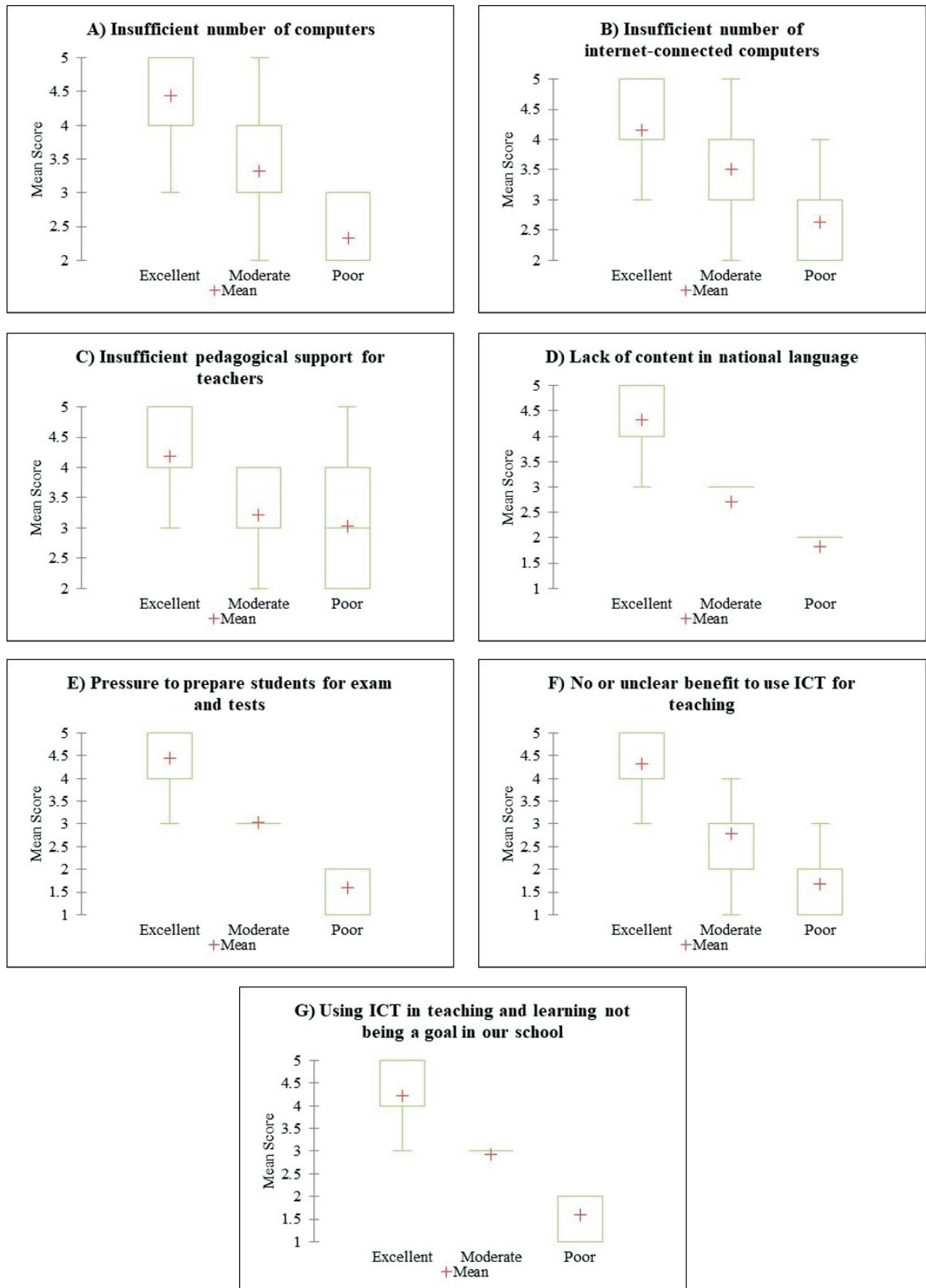
Figure 2. Significant perceived barriers parameters for excellent, moderate, and poor groups applying technology in PE.

can be attributed to the cost factor. In PE, the cost factor is undoubtedly an unavoidable barrier to maximizing the use of technology in teaching and learning. Some teachers claim that technology is too expensive, making it unrealistic for PE [14]. Such thinking is a must, where PE teachers only seek information that supports their stance on technology use. When it comes to the cost of technology as well, the budget from the technology aspect for PE is also inadequate [15]. PE teachers have cited limited budget and access to appropriate technology as prominent barriers to technology adoption [4, 5, 16]. If the school director does not recognize ICT as a resource related to PE, the effect is the integration of technology into PE cannot be supported [17]. Indubitably, the principal's influence on the budget and integration of the whole school's curriculum in terms of PE cannot be underestimated [18]. The responsible party should aim to use technology that is realistic for all teachers on a budget, not just those who have the budget to buy technology can experience it. Teachers are also encouraged to identify low-cost and no-cost technologies that PE teachers can use. Such an approach may reduce the opportunity to develop the skills to use such technology in school [19].

The barriers of insufficient pedagogical support for teachers and lack of content in the national language can be related to organizational support factors. Venkatesh and colleagues [20] emphasized that organizational support is critical to the promotion of adoption. Technology adoption is likely to be perceived as too cumbersome if the organizational culture around technology and support for its use is perceived as inadequate [4]. When PE teachers, especially those who are novices or have not yet adopted the technology, attempt to integrate it, they need support to be successful. Teachers face many challenges during the technology adoption process (e.g., loss of technology skills, technology malfunction, students not on task). According to Zhao and Bryant [21], teachers lose the technology skills they acquired in a professional program if they do not receive further support. The loss of technical skills can become a barrier to the adoption of technology in the classroom. Niess [22] also pointed out the importance of teachers' ability to manage students' behavior during technology-based instruction. Such behavior management in a technology-integrated classroom is considered one of the most challenging aspects of teaching, especially for novice teachers who lack pedagogical knowledge. Teachers must learn to manage these challenges; otherwise, they risk making suboptimal decisions includes of maintaining the status quo. Ongoing support from experienced teachers can help teachers overcome the challenges and guide them to more effective use of technology.

The current finding also indicates the perceived barrier of the pressure to prepare students for exams and tests leads to a poor degree of applying technology in PE. While this factor is often underestimated by policymakers, it has been supported by previous studies that mentioned the barrier to implementing educational technology can be a lack of time because of high-stakes testing [16] and a lack of training and time to learn [23, 24]. This demonstrates the need for quality technology integration training to help PE teachers successfully integrate technology into student learning. Since the use of ICT can mean an increased workload in terms of organizational aspects, the amount of time spent preparing for tests/exams and physical activity must be taken into consideration at PE. The majority of teachers recognize the positive aspects of technology in education but do not know how to implement it in their curriculum without sacrificing time for physical activity [25]. In this regard, technology should not replace PE instruction, but rather enhance it [26, 27]. It can be related to the level of teacher-student interaction, , the suitability of the learning environment, and learning commitment to the learning comfort [28].

In this sense, the teachers' belief that there is no or unclear benefit in using ICT in the classroom is another major obstacle. They also agreed that the use of ICT in teaching and learning is not a goal in their school. One study found that a positive attitude among teachers is a factor that enables the use of ICT [29]. The findings suggest that the basic prerequisite for its actual use is a positive attitude toward technology. The importance of attitude was discussed some time ago [30]. He examined the dependence of ICT use on attitudes toward technologies. Looking at the crucial role of attitude in the classroom, the extended results have shown that teachers' attitude is a key factor in the use of technologies in different environments [31, 32]. Due to this importance, studies have addressed the factors that create positive attitudes toward technology integration, and this suggests that more predictive resources need to be uncovered to facilitate the creation of positive attitudes [33]. Present bias makes it difficult for people to focus on long-term tasks and goals. Although many PE teachers are aware of the ability of technology to provide benefits, some PE teachers believe that the time it would take to learn and plan for technology integration would not justify its use. PE teachers must address several logistical issues, such as learning about the technology's features, planning how to introduce the technology to students, planning how to manage the technology, and considering how to use the data for pedagogical purposes, in order to effectively integrate technology into instruction [34, 35]. These processes are time-consuming, so some PE teachers believe the work is not worth it. Some PE teachers opine that they would rather engage students with

physical activity in the time it takes to implement the technology. Even though there is evidence that the technology can be beneficial to students, the cost of learning the technology and the time required to implement the technology are too high for some.

Conclusions

Awareness of these barriers has implications for physical education, curriculum design, teacher training, and youth adolescent participation in the school environment. The positive opinions and attitudes shown by PE teachers toward ICT as educational tools could pave the way for improving their digital literacy, thereby increasing their rate of use of these tools if they are provided with the appropriate technical resources and training.

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Conflict of interest

No potential conflict of interest was reported by the authors.

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