Journal of Physical Education and Sport ® (JPES), Vol.20 (6), Art 489, pp. 3629 - 3634, 2020
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Use of mobile devices as a facilitator of the practice of physical activity in physical education lessons: experience in higher education

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Published online: December 30, 2020
(Accepted for publication: December 15, 2020)
DOI:10.7752/jpes.2020.06489

Abstract:
The potential of the Technologies of Information and Communication in educational contexts has been questioned in recent years. However, the subject of physical education has now become a permeable space for including technological devices, despite the fact that there is some resistance to their incorporation into the classes. This is mainly due fears of the risk derived either from their misuse or because some schools are unable to make the investment in certain devices. This paper describes an innovative experience with mobile devices as gamifying elements in the field of physical education in higher education, by which we aimed to show the symbiotic effect of the use of technology as a facilitator of the practice of physical activity. The study also indicated that it is not necessary to provide each student with an individual device in order to obtain reliable data, as well as suitable procedures for the participants' assessment procedures. After performing different analyses based on a positivist research paradigm, we found that the experience was positively valued by the students and that the daily recommendations for moderate physical activity were improved. The validity and reliability tests confirmed that one device for every two students would be enough provide useful information regarding the students' physical demands. Incorporating technology in PE lessons has thus been shown to be satisfactory for the students.It not only favoured the fulfilment of the recommendations on physical activity but also obtainedvalid and reliable information withoutrequiring all the students to have their own individual device.
KeyWords*:* New Technologies, Gamification, Physical Activity, Outdoor activities, Teacher Training.

Introduction

The introduction of Information and Communication Technologies (ICTs) in educational contexts cannot be considered an innovation by itself (Bustamante, 2001). However, ICTs are relevant in the educational field when we seek for ways to use them for pedagogical purposes, i.e. when their use adds extra value to the teaching-learning process (Domingo, & Fuentes, 2010; Loia & Orciuoli, 2019). In this regard, the literature involves some controversialissues between authors who are in favour (Salinas, 2004) and those who are reluctant to introduce technologies such as mobile phones or tablets into the classroom (Montero &Gewerc, 2011). In the physical activity and sports context there is also a disparity of opinions on the introduction of the technology. While some studies find competition between spare time physical activity (PA) and the use of technological means (TM), especially during adolescence (Motl, McAuley, Birnbaum, & Lytle, 2006; Wong et al., 2010), the literature also contains studies that not only state that they are activities that can coexist, but that they can be compatible (Lizandra, Devís-Devís, Valencia-Peris, Tomás &Peiró, 2018; Owen, Leslie, & Salmon, 2000). Different experiences carried out in physical education (PE) have shown how a symbiotic relationship between TM and PA is feasible (Castro, Gómez-García, 2016).

Gamification is the most common methodological strategy aimed to foster the use of ICTs in educational contexts (Dicheva, Dichev, Agre, &Angelova, 2015), due to the fact that it promotes game dynamics with technology that appealsto students (Valda-Sánchez & Arteaga-Rivero, 2015). In addition, learning dynamics based on formative assessment immediate feedback and conceptual progression can be improvedby gamification (Kapp, 2012; Stott &Neustaedter, 2013). Gamification has also been used to develop strategies linked to PE contents, such as the promotion of healthy habits (Lister, West, Cannon, Sax, &Brodegard, 2014).

However, opting for gamified environments with technology in the educational field cannot only be misused by students but can also distract them from the main task (Grover et al., 2016). Part of this resistance lies in the difficulty of some educational centres, especially state-funded ones, to make the considerable investment required to bring portable devices into the classroom.

During the last decades, the use of mobile devices for self-monitoring PA has increased among students, therefore showing possible strategies to promote active lifestyles (Papalia, Wilson, Bopp, & Duffey, 2018). Recent research has shown how adolescents show higher motivation for the practice of PA due to the competition, challenge, fun and well-being variables (Portela, López-Castedo, Martínez-Patiño, Valverde-

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Esteve, & Domínguez-Alonso, 2020). For this reason, the teacher training programs could include these devices to provide a valuable follow-up challenging program for their future students. In this sense, the use of the ICTs allows obtaining an immediate feedback regarding parameters such as the motor commitment time, the average speed, and the calories consumed. All this information adds a meaningful approach that can be discussed as a health issue, by comparing the values reported to the ones suggested by the WHO (2010). Thus,didactic programs could aim at questioning students which strategies could they use to improve their PA

This work had three fundamental objectives,in addition to describing an experience in using mobile devices for the integration of PE content into higher education. The first was to determine whether the use of technology in PE classes stimulates or hinders the practice of PA,and secondly the number of devices required to obtain reliable data. The third aim was to discover the opinion of the students themselves and their degree of satisfaction with the experience.

Material & methods

Experience description

The innovative experience carried out was named *M-Urban Orientation*and consisted of conducting an orienteering race in an urban environment using smartphones as ICTs, to which we assigned different functions.

Information on the activity was previously published in the subject's virtual classroom (Figure 1), where we showed an explanatory video of the applications (previously unknown to the students), including indications for the activity. The students were organized into groups of 5 or 6 and given the map shown in Figure 2. By scanning the QR codes, they found the 'clue images' that matched with the positions indicatedon the virtual map available in the 'My Maps' application (https://goo.gl/MH88mn), where they had to take a picture of the group and an image of the corresponding clue.

Figure 1. Information posted in the subject's virtual classroom.

After completing the activity, the students showed the control imagesto the teacher-gamificatorto facilitate the data monitoring of the activity recorded in the Runtastic® application. After the experience, all the participants were asked to complete a questionnaire on different dimensions of the activity.

Figure 2. Position Map and QR codes

Participants

The experience took place at the end of January 2018 and 66 students between 22 and 33 years old (54 male and 12 female) with an average age of 25.31 (± 3.51) years, participated in groups of 5-6. All of them were students of the subject 'Learning and Teaching Physical Education', which has 16 ECTS credits (European Credit Transfer and Accumulation System) in the eighth edition of the Masters' Degree in Secondary Education Teachers at the University of Valencia.

Data collection and variables

From the information obtained from the Runtastic application, which was used by all the students during the experience, we created a database that showed the information of the 11 groups who completed the activity with the following variables: Total time (min), distance completed (km), average speed (km/h) and calories consumed (kcal). The questionnaire administered at the end of the activity was an *ad hoc* adaptation of the questionnaire on the Good Practice and Evaluation Experience (CEBPE), designed by the Spanish National Network of Formative Assessment (Castejón, Santos, & Palacios, 2015). This questionnaire consisted of 7 6-level Likert-scale items (1-Not important; 2-Less important; 3-So-so; 4-Important; 5-Very important; 6-Don't know) and one last open-answered item (https://goo.gl/uCA9bK).

Based on the ethical criteria expected in rigorous research, both the participation in the activity and the completion of the questionnaire were voluntary and anonymous. In fact, the questionnaire was only completed by 55 of the 66 people who finished the activity.

Data analysis

The statistical analysis of the data was carried out using the SPSS Version 24.0 software (SPSS Inc., Chicago, IL, USA). Firstly, we performed a descriptive analysis of the variables related to physical activity (distance travelled, motor-commitment time, average speed and calories consumed). The reliability tests (i.e., Cronbach's alpha and intraclass correlation index) were performed to study the correlation between the values obtained in the individual smartphones used by the members of the same group,first using the individual values of the devices and then the average values obtained by two mobile devices in order to determine the number of devices necessary to obtain reliable data. A correlation value was established between the students' level of satisfaction with the experience and their opinion of its usefulness for PE in secondary schools.

Results

The results obtained from the monitoring of the activity carried out with smartphones and the analysis of the experience.

Monitoring of the variables related to physical activity through the mobile devices

Table 1 shows the main values obtained from monitoring the PA involved in the M-Urban Orientation experience. This experience enhanced the hour of moderate physical activity and the participants covered a distance close to 5 km, with an overall caloric expenditure of almost 500 calories.

Table 1. Descriptive statistics of the variables related to PA

	Distance completed (km)	Motor-commitment time (min)	Average speed (km/h)	Calories consumed
Mean	4.75	71	4.06	499.8
(Standard Deviation)	(1.03)	(10.3)	(0.28)	(171.6)

Validity and reliability of the values collected by the different mobile devices

Since one of the groupshad only four mobile phones, it was decided to include four records for each group in the reliability analysis. The data from each smartphone was first analysed individually to determine whether the scores had adequate reliability values, i.e. if the scores obtained for the variables (distance, time, speed and calories) were reproducible. Since the reliability values were low (Table 2), a second correlation analysis was performed with the mean values of 2 pairs of devices, which would mean that with two devices per group of four students the values would be reproducible. In this case, the reliability values were good (above 0.6) or very good (above 0.8) (Celina & Campo-Arias, 2005).

Table 2. Reliability levels of data obtained by the smartphones

		Distance completed (km)	Motor-commitment time (min)	Average speed (km/h)	Calories consumed
1 mobile/group	ICI	0.10	0.29	0.36	0.16
	α	0.29	0.62	0.71	0.51
	p	<0.05	<0.05	<0.01	<0.05
2 mobile/group	ICI	0.72	0.99	0.80	0.60
	α	0.75	0.99	0.83	0.70
	P	<0.05	<0.01	<0.01	<0.05

Note: ICI, Intraclass Correlation Index; α, Cronbach's Alpha; *p*, statistical significance value.

These results show that, having one mobile device per group would provide insufficient information on the students' physical activity. However, the mean values of the information recorded by two devices per group would be reliable.

Assessment of experience and usefulness in PE lessons

Table 3 shows the values obtained from the good practice questionnaire used in the study. The students were quite or very satisfied with the experience. Apparently, they considered that the activity helped them to acquire professional skills that will be useful for their future practice as PE teachers.

These results were reinforced by the correlation values obtained on the degree of satisfaction with the usefulness ($r = 0.61$; $p < 0.05$) and the acquisition of professional competence ($r = 0.62$; $p < 0.05$). The group also considered that both the teacher-gamificator's indications and their classmates' collaboration facilitated the activity. They also agreed that the activity was not difficult and wouldbe useful in their future professional careers.

Table 3. Descriptive statistics of the variables related to the evaluation of the experience

	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	*Mo*	*M*	*dv*
Do you think this experience helped you acquire professional skills?	0	10.9	25.4	36.4	27.3	0	4	3.80	0.97
Do you consider what you learned with this experience useful?	0	1.9	25.9	31.5	40.7	0	5	4.11	0.86
How do you rate the indications received by the teacher?	0	0	5.6	34.4	60	0	5	4.55	0.60
How do you rate the aid received from colleagues?	0	0	14.5	41.9	41.7	1.9	4	4.31	0.74
Overall satisfaction with the experience	0	1.8	20	49.1	29.1	0	4	4.05	0.76
Degree of difficulty of the experience	21.7	60	14.5	3.8	0	0	2	2.00	0.72

Note: 1-Not important; 2-Less important; 3-So-so; 4-Important; 5-Very important; 6-Don't know; *Mo,* mode; *M,* mean; SD*,* Standard Deviation.

Discussion

Motor commitment is defined as the time during which the students carry out a motor activity in a PE session (Piéron, 1988). The urban orientation activity using mobile devices accumulatedthedaily PA time recommendedby the WHO (2010). It also generated a caloric expenditure of between 17 and 20% of the recommended caloric intake for adultsin the participants' age range (UNED, 2018),and would thus be sufficient to compensate part of the daily intake and favour control of body weight. These results confirm that technological gamification can generate a symbiotic relationship between technology and physical activity (Owen, Leslie, & Salmon, 2000). Monitoring PA can thus help to countera sedentary lifestyle and aid body weight control (Hales et al., 2017). The crucial aspect of the compatible relationship between PA and TM is the use of technological devices, which tend to encourage physical activity.The results show that one device between two students is enough to collect reliable information and means that schools could make a lower investment in technological devices and reduce the educational barriers regarding the introduction of technology (Cabero-Almenara, Vázquez-Cano, & López-Meneses, 2018; Cebrián, 1997).

Finally, based on the assessment of the experience, the students were found to be quite or very satisfied with the activity and appreciated both the indications of the teacher-gamificator and the collaboration of the rest of their classmates. In fact, they believe that the activity is easy to reproduce or adapt to their future interests. Similar results were also found in similar studies on gamification experiences with technology, especially when they found a balance between the difficulty of the challenge and the participants's ability to face it (Kim & Lee, 2015; Bicen&Kocakoyun, 2017).

In this regard, far from understanding the use of technology as a threat to learning (Grover et al., 2016; Swing, Gentile, Anderson, & Walsh, 2010), it seems that it allowed them to acquire useful professional skills (Borowski-Beszta & Polasik, 2020) that will be useful in their future careers as PE teachers, suggesting that the problem is not in the use of mobile devices in classrooms, but in the purpose for which they are used.

This paperdescribes a successful experience in the use of mobile devices for working with PE contents in higher education, being one of the few studies in the Spanish context that shows a symbiotic and beneficial relationship between the combination of technological means and physical activity. It also provides evidence on the number of devices (mobile phones, electronic tablets, wristbands or activity clocks) necessaryfor PE lessons to obtain reliable results. However, the study is not exempt from some limitations;for example although all the participants used the application (Runtastic) to monitor the activity, they did so on different mobile devices,which may have influenced the accuracy of the data. In addition, some of the time lags in the durationof the activity were greater than we expected, due to the fact that not every student started their devices at the same

time and some batteries ran out during the activity. In future experiences all the groups should use the same type of device, the same application, and start the activity at the same time.

This type of activitycould be transferred to students' daily lives, as it is one of the key objectives of the PE subject and could be complied with in other ways, possibly by making a tour of familiar landmarks in a city. Since it is a moderately intensive activity it can be performed by a wide range of the population. We consider that, if the work reaches the professional teachers in PE and other areas of the primary and secondary levels, it could be a stimulus to incorporate the ICTs in their daily activities. Somehow, if ICTs are already part of people's daily lives, there is no place for it to be outside educational settings.

Conclusions

The M-Urban Orientation was considered to be a satisfactory experience by the participating students. A symbiotic relationship among ICT and PA was also found, considering the activity contributes to fulfil the daily PA motor commitment time. The validity and reliability of the information obtained by the smartphones suggest that a ratio of one device for every two students would provide useful and generalizable activity data and is an appropriate technology for incorporating into schools. In terms of utility, having found reliable information with pupils working in groups and without requiring that every student have their own device, provides an interesting insight for families and schools to decrease the investment on educational technology. Nonetheless, further designs on M-learning research must consider the homogeneity of technologic devices as a mean of increasing the instrument validity. Moreover, monitoring healthy styles in children and adolescents in order to reduce the barriers or improve the motivation for the practice of PA, could be an interesting research aim as well.

Conflicts of interest –The authors declarethat they have no conflict of interests.

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