Article

Impact of Applying Information and Communication Technology Tools in Physical Education Classes

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Abstract: The authors of the present study explored how ICT devices used in P.E. lessons determine psychomotor performance, perceived motivational climate, and motivation. The students were allowed to use ICT devices (smartphone, webpages, Facebook) during a four-week intervention. In the course of the research project aimed to assess the impact of the application of ICT devices on performance and motivation, the participants were divided into two test groups and one control group. The sample consisted of secondary school students including 21 males and 64 females with the M_{age} = 16.72 years. The results showed that in groups where ICT devices were used, performance ($p = 0.04$) and task orientation ($p = 0.00$) significantly improved. Meanwhile, in the group in which ICT devices were not used, the intervention resulted in improved performance ($p = 0.00$) and by the end of the project, this trend was coupled with increased Ego orientation ($p = 0.00$) and higher rate of amotivation ($p = 0.04$). It can be concluded that the use of ICT tools has a positive impact on performance and motivation.

Keywords: physical education; motivation; learning outcomes; perceived motivational climate

1. Introduction

Regular physical activity and physical education (P.E.) classes in school play a crucial role in promoting the awareness of healthy lifestyles among the youth. Considering regular physical activity as "medicine", the Physical Activity Strategy from the WHO for the European region (2016-25) reinforces the significance of activity for children and adolescents [1]. However, we cannot forget the fact that today's young people were already born into the digital world of the 21st century. Today's modern world is inseparable from Information and Communication Technology (ICT), which has appeared in all areas of our lives [2]. The increase in time spent using the Internet, mobile phones, and various digital devices can affect the time young people spend moving and being physically active.

According to some previous literature, the increasing use of digital technological devices reduce the willingness for physical activity [3], and increased screen time can reduce sleep time and physical activity [4] while reducing screen time can contribute to a healthier body weight in adolescents [5]. At the same time, various ICT devices (heart rate monitor, pedometer, smartphone, mobile applications) are excellent tools for measuring physical activity and analyzing its quantitative and qualitative indicators. Nowadays, in addition to professional sports and recreational sports, their use has also appeared in school physical education.

The use of heart rate monitors and pedometers in physical education lessons has been investigated by many previous studies, which mostly showed positive results [6–9]. The results of Yang et al. [10] showed that the number of mobile learning papers is increasing year by year, similar to the use of mobile technologies in physical education activities.

According to Yu et al. [11], there is a need for investigations with mobile applications that can be used in the teaching–learning process of physical education, which can be facilitated by the fact that digital technology in the lives of most high school students,

including smartphones and various mobile applications, social networks, and websites, has become commonplace [12–14]. The previous studies in the field of school physical education related to the use of mobile applications showed positive results in terms of motivation and improvement of student autonomy and evaluation [13,15–17]. According to Greve et al. [18], the key issue for the successful use of mobile applications in physical education is the planning of the learning activity and its connection with the curriculum [19]. Lee and Gao [20] recommend the selection of mobile applications used in physical education classes for learning purposes.

According to Vega-Ramírez et al. [13], one of the motivating tools for promoting exercise can be the use of sports mobile applications, which can be used to collect important data such as the level of daily physical activity and the distance covered, and share these with others [21]. A number of applications which support physical activity are based on behavioral theory and use some elements of gamification for success, for example by marking personal goals and providing specific feedback [21]. The emergence of gamification as a methodology in the field of education is still considered new but it is becoming increasingly popular [22].

The purpose of the studies conducted in compulsory education was to examine the psychological effects on students. In these studies, the gamification methodology was used as a motivational strategy in order to learn the curriculum content [23,24]. According to Quintas and Bustamante [23], gamification can represent an innovative role in the promotion of physical activity, although its real effects are still less known. Fernandez-Rio et al. [24] found that the use of gamification increased students' intrinsic motivation in their study of primary and secondary school students.

In this research, we used a mobile application selected by us (Runtastic, Pasching, Austria), a website designed for information and data communication, and a private Facebook group. Our aim was to examine the effect of the use of these ICT devices in physical education lessons on psycho-motor performance, perceived motivational climate, and motivation.

1.1. Self-Determination Theory and Motivation

Motivation is a significant component and a triggering factor of human behavior. Paic [25] believes that children or students are often not motivated appropriately by parents, teachers, or sports experts to devote the necessary amount of energy to physical activity, to develop a high level of persistence and commitment, and to overcome the respective obstacles and setbacks.

Self-determination theory (SDT) provides a framework system applicable to sports as well. As in sports, participation in physical education lessons can also be explained by this theory. As Deci and Ryan [26] assert, motivation requires a feeling of competence regarding the given activity, the option of individual and group-based decision making (autonomy), and the maintenance of personal connections with peers and teachers (need for bonding, relatedness). This theory considers both extrinsic and intrinsic motivations that are significant in physical education. As the path model of the self-determination theory indicates, demotivated behavior is coupled with a low level of autonomy, while strong intrinsic motivation results in an equally high level of autonomy [27,28]. Thus, task performance or fulfilment in P.E. classes includes extrinsic motivation (peers, teacher, objectives) and intrinsic motivation (enjoyment of learning, curiosity, experience, joy).

According to the self-determination theory, extrinsic motivation can be either self-determined or non-self-determined. Extrinsic motivation becomes self-determined if the motivational factors (motivators) of the given activity are accepted or internalized. Accordingly, the student will demonstrate greater commitment and make a higher effort to complete the given activity. However, when such conditions are not applicable, the student will feel stressed and forced to perform, which will result in poorer achievements [26,27].

In the past decades, the self-determination and achievement–goal theories presented the dominant models to explain and explore the motivation processes related to the behav-

ior of students and athletes [29,30]. Ntoumanis [31,32] asserts that intrinsically motivated students have a higher level of self-esteem if they consider the given task a challenge or if they can select the difficulty level of the respective assignment. Consequently, they exert a higher level of effort as well. High intrinsic motivation can result in greater willingness to perform [33,34] while performance implies challenge [35]. Conversely, high extrinsic motivation leads to increased anxiety [34], and since performance does not imply challenge, attrition becomes frequent [36]. Young athletes and students display a self-determined attitude to P.E. and sports in general if their needs for autonomy, a factor whose fulfilment significantly depends on the immediate environment, are met. Consistent reinforcement of the feeling of competence along with independence and free decision making options provided in appropriate framework or context can lead to increased intrinsic motivation [27,28], a basic requirement for participating in P.E. lessons. In the case of stricter control, young athletes can experience anger and frustration [37], having an impact on their performance as well.

Having surveyed 142 articles in their review of the application of the SDT model in physical education, Berghe et al. [38] called for a stronger connection between pedagogy and psychology in a practical context. On the one hand, this means the expansion of psychology-related knowledge of P.E. teachers and the promotion of a practical orientation of research over the "theoretical" aspects. Such criteria include (a) exploring teacher behaviors that influence students, (b) considering contextual factors that have a major impact on the given climate, and (c) fostering an optimal motivational environment that supports student performance.

1.2. Perceived Motivational Climate

Physical education plays a significant role in promoting physical activity and a healthy lifestyle, and the given motivational context determines the outcome of the respective lesson. Recently, several studies have demonstrated the importance of motivation in relation to physical activity while the achievement–goal theory was applied in the context of a healthy lifestyle and physical education [39,40]. Henriksen et al. [41] highlighted the significance of this model along with its role in the formation of psychosocial factors.

Ames and Archer [42] identified two objectives regarding motivation: task/mastery and ego/performance. Several research results indicate that a task-oriented climate increases the motivation and the confidence of athletes [43]. Since a correlation can be discerned between self-confidence and goal orientation, a positive connection exists between motivational orientation and self-confidence among task-oriented students. The learners who display a higher level of motivation generally perform better. A task-oriented person would like to improve their performance and skills; thus, their motivation is directed at the given assignment.

Relying on their knowledge, they want to provide their best performance as they only feel successful if they realize their self-established objectives [44]. Task-oriented students are likely to have higher intrinsic motivation coupled with more intensive physical activity and cooperation with others. Accordingly, exercise providing satisfaction will become a positive experience, and personal development will be emphasized [45]. This type of motivation results in a long-term commitment to physical activity [46]. Previous research results demonstrated the necessity of task/mastery or a task-oriented attitude in motivation for active participation in physical education classes and high-level sports performance [47].

An ego-oriented person can experience difficulties if their skills are compared to others, and, when compelled to prove themselves, they tend to become anxious. They consider their achievement successful if they match the performance of their peers with a lesser effort or even surpass it. Students displaying such attitude often believe that their skills are limited and cannot be further developed. Furthermore, self-oriented people are more likely to set objectives whose realization is connected with social status, recognition, or increased material wealth. All these factors, however, are connected with the risk of failure perception and they often lead to attrition or termination of the physical activity [48].

Researchers have identified gender-based differences related to motivation. Accordingly, men have a higher level of ego-orientation, while women display stronger task-orientation [49]. As far as education is concerned, a task-oriented climate is coupled with positive behavior and intrinsic motivation for learning [50,51]. Likewise, an ego-centered climate is positively related to extrinsic motivation, and it is more frequent among students who aim to obtain greater recognition in school.

1.3. Purpose of the Study and Hypotheses

Our research aims to assess the impact of ICT (smartphone, Runtastic mobile application) use in physical education on student performance and motivation. An additional objective is to explore the correlation between the motivational climate and the motivation during an ICT-supported project along with the potential results of the active inclusion of students in the intervention. We have established the following hypotheses: (a) since learning is more efficient in P.E. classes supported by ICT devices than in P.E. lessons, students participating in the intervention will perform better than those not using such tools; (b) the ICT supported test group has a task-oriented perceived motivational climate, and the intervention will result in an increasingly task-oriented attitude; and (c) the use of ICT devices has a positive impact on motivation, and as a result of the intervention, intrinsic motivation will become stronger.

2. Materials and Methods

2.1. Participants

The participants of the research project included Hungarian students in the 11th grade of secondary school. (21 male, 64 female, Mage = 16.72 years, SD = 0.50). The pupils were mostly from a middle class socioeconomic background. The participants were allocated into three groups. Test group 1 with 26 members (13 male, 13 female) was subjected to an ICT-supported intervention and received ICT-based teaching, while Test group 2 containing 34 members (6 male, 28 female) was taught by traditional teaching methods and did not receive ICT support. In the case of the control group consisting of 25 participants (2 male, 23 female), there was no intervention or ICT support. The research was carried out in three classes (year 11), randomly selecting which class was the Test group or control group. In Test group 1, students were further divided into two groups using a 20 m shuttle run test.

2.2. Procedure

The pedagogy-focused study was conducted at the beginning of the academic year. The testing process included three classes and the given learning–teaching unit focused on general athletic skills with special attention to endurance. Test group 1 had to carry out a task titled *Run around Lake Balaton!* calling on students to virtually complete a 221 km distance-run around the largest lake in Hungary. The duration of the project was 12 lessons delivered in four weeks. During the first two lessons, the emphasis was on theory as the P.E. teacher participating in the project familiarized the students with the main features of the assignment (objective, device use, task description). Students could select a running task with the length of 10, 12, or 15 min in the remaining classes. Members of Test group 1 participated in P.E. classes via ICT-supported cooperative learning. The respective support included a smart phone application, private Facebook group, and a specific website. A GPS-based mobile application, Runtastic, was used to measure and record the respective time and distance, but the P.E. teachers recorded the data on paper as well. At the end of each lesson, the students uploaded their scores or results into a private Facebook group.

Moreover, during the four weeks, participants could monitor their own and their group's performance on a website, and the "actual" position of their virtual running was recorded on a map too. The 20 m shuttle run test probing endurance or stamina was performed before and after the intervention. The participants also had to complete a PMCSQ-2 questionnaire and an SMS questionnaire along with taking part in a focus group interview.

Members of Test group 2 participated in P.E. lessons without ICT support and the project method was not applied either. The students had to take their physical condition and skills into consideration and independently choose the length of their running (10, 12, 15 min), and their results were recorded on paper by the respective teacher. There was no intervention in the Control group, and the students participated in a traditional lesson with the same duration as the length of the given intervention. The control group did participate in P.E. lessons as well. In accordance with the curriculum, they had three P.E. lessons per week similar to the two experimental groups. The topic of the learning unit was the development of general athletic abilities.

Since students participated in the research project during school sessions, both principals and parents were contacted in order to acquire permission for collecting the respective data. While physical education classes were taught by subject teachers, the researchers were present as well. The results were recorded, and the surveys were completed during the P.E. classes. A researcher participating in the given program was present during the completion of the respective questionnaire. Pursuant to the Declaration of Helsinki (2008), the participants were informed of the objective of the research program and of the use of the given research results. The exploration was approved by the Ethics Committee of the University of Physical Education (No. TE-KEB/21/2021).

2.3. Measures

2.3.1. Motor Performance (20 m Shuttle Run Test)

The 20 m shuttle run test was used as the direct measurement for the performance of the students. The purpose of the 20 m shuttle run test was the assessment of cardiovascular fitness (aerobic capacity). The students had to complete a maximum number of 20 m distances with a speed dictated or determined by the enclosed audio material. The main feature of the test is progressive intensity, with a gradually increasing difficulty level from the beginning. The audio text related to the test prescribed 21 levels with continuously increasing difficulty grades every minute. The students were allowed 9 s to complete the distance in the first stage, and the time requirements continuously decreased by 1.5 s. The new segments were indicated by sound signals. The test ended if the student had committed their second error, that is, if they could not reach the line by the signal or could not continue running.

2.3.2. Perceived Motivational Climate

In order to assess the Perceived Motivational Climate, we relied on the PMCSQ-2/Perceived Motivational Climate in Sport Questionnaire/[52]. The questionnaire is widely used for the measurement of motivation in physical education and sports [53]. The questionnaire includes two main sections: Task and Ego, each with 33 questions complemented by a subscale of 3 questions. The subscale belonging to the Task main scale and contained the following items: Cooperative learning, Important role, and Effort/environment. The subscale related to the Ego main scale consists of Punishment for mistakes, Unequal recognition, and Intra-team member rivalry.

The validated Hungarian version of the questionnaire is the H-PMCSQ-2 prepared by Révész et al. [54]. The questionnaire includes close-ended questions facilitating the assessment of the answers on a continuum of 1 to 5 indicating approval and disapproval. Cronbach's alpha value for the second order factors was $\alpha = 0.82$ for the Task climate, and $\alpha = 0.820$ for the Ego climate. All the first-order factors showed acceptable values of internal consistency (0.7<).

The willingness of students to learn, their ability to acquire knowledge and improve jointly with their team members, and the respective belief can be measured by the Cooperative learning subscale. The Important role subscale evaluates the position of a given student within the team via adapting their own performance to the team's needs. The Effort/improvement subscale indicates the significance learners attribute to development, along with their openness to new methods and motivation toward further growth.

The Punishment for mistakes subscale of the Ego-oriented main component facilitates the assessment of fear related to underachievement and mistakes. The Unequal recognition subscale shows whether the instructor recognizes performance unequally, and the assessment of this category depends on the given individual. The values concerning the Intra-team member rivalry allude to the level of internal conflicts or rivalry impacting success within the team.

2.3.3. Sport Motivational Scale

We relied on the Hungarian version of the SMS questionnaire/Sport Motivational Scale/[55] prepared by Tsang et al. [56]. The questionnaire containing 28 questions assesses the athletes' motivational orientation in three categories: amotivation, extrinsic motivation, and intrinsic motivation on a scale of 1–7. The internal consistency of alpha value varying from 0.71 to 0.85 at the pre-test, and from 0.69 to 0.85 at post-test.

In case of amotivation, the person takes on a sport due to external influence without the need to fulfill a self-set goal or prove themselves to others. Extrinsic motivational values show the extent of the athlete's desire to fulfill externally imposed criteria or meet the expectation of others. In this case, the athlete does not want to achieve a goal set by themselves as the main objective is to fulfill the expectations of another person. High intrinsic motivational values indicate the desire and need for success during the given sports activity implying a sense of accomplishment, the desire to prove something to oneself, and self-actualization.

2.4. Data Analyses

In order to process the general information and data related to the research we relied on, descriptive statistical analyses were used along with utilizing parameter-based procedures for the determination of differences [57]. The Likert-scale applied in the questionnaires facilitates the application of parameter tests [58].

The statistical analyses were performed with the SPSS 21.0 program while considering the margin of error generally accepted in social science research ($p < 0.05$) as the level of significance.

The differences between the groups were explored with the Independent T test, and we applied variance analysis complemented by post hoc procedure in the case of a number of variables while we deployed a one-sample T-probe for monitoring the changes. We observed the criteria related to the specific analyses and evaluated the given results only when the criteria system of the analysis including homogeneity and distribution made that possible [58].

3. Results

3.1. Learning Outcomes

The psychomotor performance of students in light of learning outcomes was tested before and after the intervention (20 m shuttle run test). We relied on a one-sample T-test to determine whether a significant difference existed before and after the intervention. Our results suggest that a significant difference can be discerned concerning the pre-and post-intervention data in both test groups. The average differences were 117.69 and 85.29 m in Test group 1 and Test group 2, respectively. There was no change of performance in the control group during the duration of the project (Table 1).

Since both groups displayed improved performance, we explored the potential difference between the respective improvements. The ICT-supported group achieved significantly better results both on the pre- and post-intervention measurement. The average pre-intervention figure of 196.74 m increased to 229.14 m on average after the post-intervention measurement (Table 2).

Table 1. A group-based breakdown of student performance prior to and after intervention.

Group	Pre-Test (20 m Shuttle Run Test in Meters)	Post-Test (20 m Shuttle Run Test in Meters)	Pre-and Post-Test Difference (in Meters)	Sig.
	$M \pm SD$	$M \pm SD$		
Test group 1	726.15 ± 448.27	843.85 ± 471.01	117.69	* 0.04
Test group 2	529.41 ± 267.43	614.71 ± 303.52	85.29	* 0.00
Control group	510.40 + −264.77	512.80 ± 277.60	2.4	0.07

* $p < 0.05$.

Table 2. Differences between the two test groups (pre- and post-intervention measurement).

Group	Pre-Test (20 m Shuttle Run Test in Meters)	F	Sig	T	Post-Test (20 m Shuttle Run Test in Meters)	Pre-and Post-Test Difference (in Meters)	F	Sig.	T
	$M \pm SD$				$M \pm SD$				
Test group 1	726.15 ± 448.27	12.43	* 0.03	2.11	843.85 ± 471.01	117.69	7.17	* 0.02	2.28
Test group 2	529.41 ± 267.43				614.71 ± 303.52	85.29			

* $p < 0.05$.

Our project aimed to explore whether students can run around Lake Balaton, even virtually. Since the members of the given age group are not permitted to participate individually in a competition of such magnitude, we wanted to determine whether the performance of the given groups was sufficient to complete the respective distance. We also wanted to determine whether the use of ICT devices had a motivating effect. The students could trace and monitor the distance covered by their group on a daily updated website. The website was designed to show how the students were progressing in the project (Figure 1). By the end of the project, Test group 1 fulfilled the task and completed the 221.8 km Lake Balaton run.
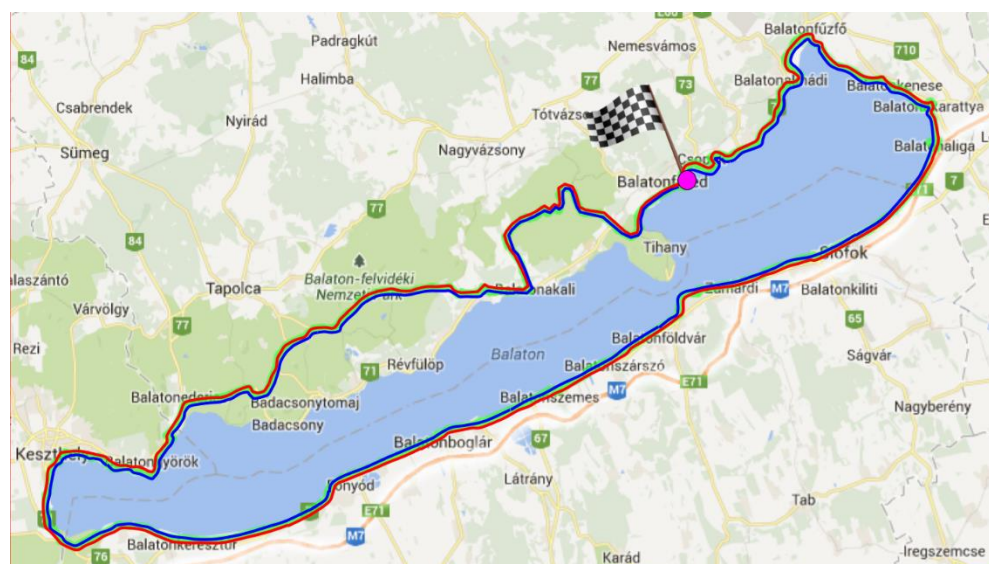
Figure 1. The website used to monitor performance in the project.

In context of the self-determination theory, students were given the option of freely choosing the duration of each run (autonomy). Figure 2 shows the percentage-based distribution of running distances (10′, 12′, 15′) during the 10 attempts made by the two test groups. The students in Test group 1 tended to choose shorter durations (10′, 12′) at the beginning, but in the second half of the project, a change was discerned as more participants

selected longer runs (12′, 15′). Consequently, 98.5% and 100% of the participants chose the longest term (15 min) in the ninth and tenth attempt, respectively.
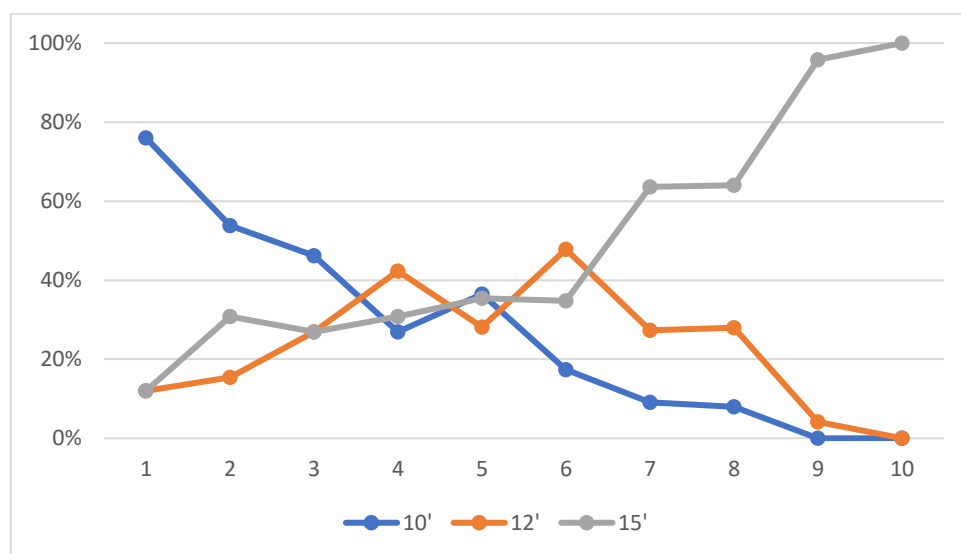

Figure 2. The distribution of selected run times in Test Group 1.

The students of Test group 2, in which ICT support was not available, mostly chose the shortest running durations throughout the project. No one selected the longest duration and the medium time was only chosen four times (Figure 3). The selected durations showed a strong connection (Cramers' V = 1); thus, in the ICT-supported group, by the end of the project students chose the 15 min segment instead of the 10 min segment (Chi2; $p = 0.000$).
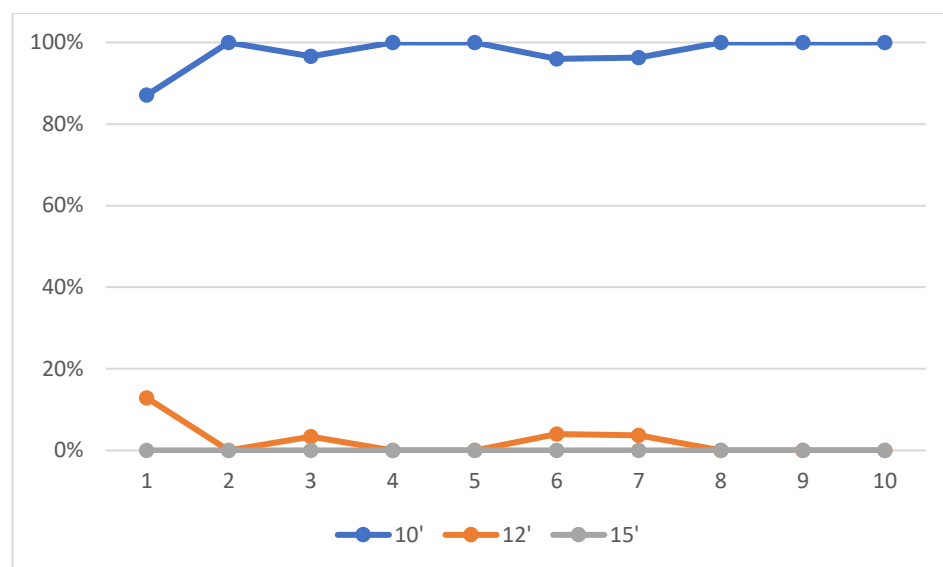

Figure 3. The distribution of selected run times in Test Group 2.

A close correlation was discerned between the groups and the distances covered. In Test group 1, better results were achieved regarding the distances in all ten runs. Test group 2 did not post any outstanding results to be measured, as they covered shorter distances due to the selected shorter duration. In light of the selected duration, it can be concluded that in the case of choosing longer running times, greater distances were covered (Table 3). The analysis of the selected time length and the distances completed led to the conclusion that in the ninth and the tenth run, the students of Test group 1 covered a significantly

greater distance both compared to their earlier performance and to that of the members of Test group 2 (*p* = 0.017).

Table 3. The percentage-based distribution of the selected times.

Group	Sex	*Run 1*			*Run 2*			*Run 3*			*Run 4*			*Run 5*		
		10′	*12′*	*15′*	*10′*	*12′*	*15′*	*10′*	*12′*	*15′*	*10′*	*12′*	*15′*	*10′*	*12′*	*15′*
Test group 1	Avg.	76	12	12	53.8	15.4	30.8	46.2	26.9	26.9	26.9	42.3	30.8	56.8	13.2	29.9
	Male	66.7	16.7	16.6	38.5	23.1	38.4	53.8	30.8	15.4	30.8	30.8	38.4	63.6	18.2	18.2
	Female	84.6	7.7	7.7	69.2	7.7	23.1	38.5	23.1	38.4	23.1	53.8	23.1	50	8.3	41.7
Test group 2	Avg.	73	27	0	100	0	0	96.6	3.4	0	100	0	0	100	0	0
	Male	50	50	0	100	0	0	80	20	0	100	0	0	100	0	0
	Female	96	4	0	100	0	0	100	0	0	100	0	0	100	0	0
		Run 6			**Run 7**			**Run 8**			**Run 9**			**Run 10**		
		10′	12′	15′	10′	12′	15′	10′	12′	15′	10′	12′	15′	10′	12′	15′
Test group 1	Avg.	15.3	48.1	36.5	9.1	27.3	63.6	8	28.2	63.7	0	3.8	96.1	0	0	100
	Male	30.7	46.2	23.1	9.1	18.2	72.7	7.7	23.1	69.2	0	7.7	92.3	0	0	100
	Female	0	50	50	9.1	36.4	54.5	8.4	33.3	58.3	0	0	100	0	0	100
Test group 2	Avg.	87.5	12.5	0	90	10	0	100	0	0	100	0	0	100	0	0
	Male	75	25	0	80	20	0	100	0	0	100	0	0	100	0	0
	Female	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0

The difference between males and females concerning the selected duration was analyzed using the Chi 2 test. It can be concluded that females chose significantly (*p* = 0.040) lower durations (10′) than males, who tended to select the segments with the longer duration (15′). No significant differences could be ascertained in Test group 1 as both males and females chose similar time intervals, while in Test group 2 during several attempts (1, 3, 6, 7), a significant difference (*p* = 0.003; *p* = 0.026; *p* = 0.019; *p* = 0.033, respectively) could be identified in favor of females in all cases, as they chose shorter distances.

3.2. Motivational Climate

We also aimed to assess the changes in the perceived motivational climate during the project. Consequently, we administered the PMCSQ questionnaire before and after the intervention. The participants of Test Group 1 and Test Group 2 were asked to complete the questionnaire both before and after the intervention. In Test group 1, the pre-intervention test revealed a higher result (3.19) regarding the Task scale than the Ego scale (2.47) as shown in Table 4. As far as the subscales of the main scales are concerned, the Effort/improvement subscale showed the highest value with a score of 3.52, while in case of the Ego main scale, the highest value was indicated by the Intra-team member rivalry subscale at a score of 2.93. The results of the post-intervention test revealed that the respective values increased all subscales. The one-sample T-probe indicated a significant difference in the Task main scale along with the Cooperative learning and Effort/improvement subscales. In both cases, the respective results improved in a statistically detectable manner.

Table 4. The results of the PMCSQ questionnaire in Test group 1.

	Pre-Test $M \pm SD$	Post-Test $M \pm SD$	Sig.
TASK	3.19 ± 1.18	3.53 ± 1.18	* **0.00**
Cooperative learning	2.92 ± 1.22	3.32 ± 1.15	* **0.02**
Important role	2.93 ± 1.18	3.16 ± 1.28	0.09
Effort/improvement	3.52 ± *1.08*	3.92 ± 1.01	* **0.00**
EGO	2.47 ± 1.31	2.37 ± 1.24	0.16
Punishment for mistakes	2.07 ± 1.26	2.10 ± 1.21	0.82
Unequal recognition	2.63 ± 1.31	2.31 ± 1.21	* **0.01**
Intra-team member rivalry	2.93 ± 1.18	3.16 ± 1.28	0.95

* *p* < 0.05.

In Test group 2, the Task and Ego main scale showed similar results to those of Test group 1, as no significant differences were discerned. The highest values were received in the Effort/improvement and Intra-team member rivalry subscales. During the post-intervention tests, no significant differences were shown in the Task main scale and its subscales, but significant differences were observed between the Ego main scale and two of its subscales: Punishment for mistakes and Unequal recognition (Table 5).

Table 5. The results of the PMCSQ questionnaire in Test group 2.

	Pre-Test $M \pm SD$	Post-Test $M \pm SD$	Sig.
TASK	3.02 ± 1.23	3.06 ± 1.15	0.55
Cooperative learning	2.79 ± 1.08	2.88 ± 1.07	0.49
Important role	2.54 ± 1.19	2.66 ± 1.13	0.25
Effort/improvement	3.49 ± 1.16	3.44 ± 1.10	0.55
EGO	2.26 ± 1.19	2.56 ± 1.18	* **0.00**
Punishment for mistakes	2.04 ± 1.16	2.26 ± 1.09	* **0.03**
Unequal recognition	2.27 ± 1.18	2.66 ± 1.19	* **0.00**
Intra-team member rivalry	2.67 ± 1.18	2.91 ± 1.20	1.38

* $p < 0.05$. PMCSQ-2.

3.3. Motivation

The project included the examination of the change in motivation in both test groups using the Sport Motivation Scale (SMS). Table 6 shows that in case of Test group 1, the highest values were scored pertaining to extrinsic motivation, as the students were primarily externally motivated. We received similar values for intrinsic and extrinsic motivation as well.

Table 6. The results of the SMS questionnaire in Test group 1.

SMS Scale	Pre-Test $M \pm SD$	Post-Test $M \pm SD$	p
Extrinsic motivation	2.89 ± 0.63	2.91 ± 0.57	0.93
Intrinsic motivation	2.79 ± 0.43	3.00 ± 0.50	* **0.01**
Amotivation	2.73 ± 0.53	2.76 ± 0.58	0.85

* $p < 0.05$.

Following the implementation of the project, extrinsic motivation showed a minimal increase similar to amotivation, while intrinsic motivation significantly increased. Consequently, by the end of the project, the level of intrinsic motivation was the highest as a result of the aforementioned significant growth.

Table 7 shows that in Test group 2, the level of intrinsic motivation was the highest before the project, surpassing even the value of Test group 1. The lowest dimension was related to amotivation.

Table 7. The results of the SMS questionnaire in Test group 2.

SMS Scale	Pre-Test Sum	Post-Test Sum	p
Extrinsic motivation	2.58 ± 0.42	2.74 ± 0.47	0.12
Intrinsic motivation	2.86 ± 0.45	2.72 ± 0.37	0.13
Amotivation	2.35 ± 0.56	2.62 ± 0.51	* **0.04**

* $p < 0.05$

By the end of the project, the value of intrinsic motivation decreased, extrinsic motivation increased, and amotivation increased significantly.

4. Discussion

In our research, we aimed to assess the impact of ICT devices (smartphone, mobile application) on student performance and motivation in addition to the potential legitimacy or significance of the use of ICT in physical education instruction. The results confirmed that student performance is correlated with ICT use, as performance and motivation were higher in groups in which ICT devices were used. The use of these devices significantly improved the students' motivation, performance, and task orientation. In Test group 1, the students' performance was better and they were more motivated than in Test group 2, which is thought to be due to the impact of the ICT tools.

In light of the self-determination theory, we explored how the autonomy-oriented climate impacts performance and the task-related attitudes of students. All in all, it can be concluded that while both groups showed improved performance, in the group supported by ICT devices significant differences could be discerned between pre- and post- test scores. Furthermore, students tended to choose longer assignments in the second half of the project and therefore they covered greater distances. Therefore, each run or completed stage brought them closer to completing the whole distance of 221 km. The aggregate results of the respective runs could be monitored by a website that enabled students to witness their own performance and progress.

Relying on the self-determination theory, Deci and Ryan [26] concluded that individual motivation requires that one feels competent to carry out the given activity, has an option to make decisions alone and with others, and establishes a connection with peers and teachers. Our research results confirmed that if students are allowed to select their tasks freely and are given an appropriate objective, both individual and group results will improve. In the 10th run, 100% of students in the ICT-supported group chose the task with the longest duration thereby improving their own scores and that of the respective group. In the group not supported by ICT devices, students chose tasks with shorter durations, and they were not fully committed to completing the 221 km run.

Thus, it can be concluded that students monitoring their own performance with ICT devices and receiving feedback, gained an incentive for further improvement. Consequently, we recommend the integration of ICT devices into measuring and monitoring performance along with the support of the respective learning process. Through the use of ICT tools and continuous feedback on performance, the students' achievement and motivation increased. Our research reinforces the previous research results of Legrain et al. [59], which showed that the application of ICT devices promotes perceived self-competence and autonomy while positively impacting psychomotor performance.

Our research results suggest that ICT devices can be integrated into everyday educational practice, as their use encourages higher levels of student performance. The use of gamification in education can increase motivation and performance [23], and the results suggest that the use of ICT tools has a similar effect.

Such data correspond with and confirms the findings of Park et al. [60] who stated that the inclusion of smart phones into instruction raises motivation levels and promotes goal-oriented use.

Our research extended to the impact of ICT use on the perceived motivational climate. The motivational climate provided by the instructor determines performance and students perform better in a task-oriented climate [44]. While Ortega et al. [53] identified a correlation between Task orientation and Ego orientation and physical education, it was revealed that students performed better in a task-oriented climate. The exploration of the pre-intervention motivational climate revealed no significant difference between the two groups concerning the respective main or subscales. In Test group 1, all task-orientation values increased as students became increasingly task-oriented. In the Effort/improvement and Cooperative learning subscales, significantly higher values were received at the post-test measurement. Thus, it can be concluded that ICT use has an overall positive impact while strengthening collaboration, task-orientation, and cooperative learning. As for the Unequal recognition

subscale, the specific scores showed a significant decrease leading to the conclusion that students felt equal in the group and the individual differences were not visibly present.

In Test group 2, the scores related to the Ego main scale significantly increased, especially the Punishment for mistakes and the Unequal recognition dimensions. Compared to Test group 1, this is a conflicting result. The increase in the values of the Ego subscale showed a stagnation of student performance and of the duration of the given run primarily because students did not consider high performance important, and the emphasis on differences between students had a negative impact on performance. It is highly likely that students continuously chose the shortest running times for this reason.

Gonçalves, Coelho, Cruz, Torregrosa, and Cumming [45] and others [61,62] concluded that task-oriented students performed better and have a higher level of intrinsic motivation. Our research results confirmed these findings as we have shown that ICT-supported learners performed better, had higher task orientation levels, and showed greater motivation in accomplishing their goals along with high levels of performance.

The fluctuation of motivation was tested with the Sports Motivation Scale utilized both in the pre- and post- intervention tests. In the ICT-supported group, the level of extrinsic motivation was the highest at the beginning of the project, which further increased by the completion of the project. The reason for this was the increased motivation brought on by the device use. Nevertheless, it can be concluded that the level of amotivation did not show a major change. In other words, students were motivated to perform when reinforced by the significant change or the improvement of intrinsic motivation. The intrinsic motivation of students significantly improved by the end of the project. In Test group 2, however, the level of amotivation showed significant increase, as students lost their motivation by the end of the project and displayed less willingness to cover the distance. This was also shown by the fact that 100% of students selected the shortest duration tasks in the second half of the project.

According to Ntoumanis [63], Baena-Extremera et al. [64], and Manninen and Campbell [65], students with higher intrinsic motivation have a stronger self-esteem, and if a given task imposes an appropriate challenge or if they can select the difficulty level of the assignment, they will make a greater effort. Our research results confirmed these findings, as the intrinsic motivation of students significantly improved in an ICT-supported environment as increasingly longer durations and distances were selected. Thus, greater efforts were made to complete a project that was considered to present a worthy challenge.

5. Conclusions

In the case of a subject emphasizing physical activity like physical education, the use of ICT devices is not a general trend [66]. However, positive research results suggest that ICT tools should also be tested and used in physical education teaching. A study by Vega-Ramírez [13] on smartphone use came to the same conclusion.

ICT devices increase the performance and motivation of students while contributing to a motivational climate that facilitates high level achievements. At the same time, we consider it important to point out that the use of tools alone does not contribute to the effectiveness of the teaching–learning process in terms of physical education. The use of tools should have a specific purpose, which the students are informed of. The use of the devices for learning purposes should be taught to the pupils and they should be made aware that they are being used for learning purposes in the classroom.

In order to adapt the use of ICT tools in classrooms to achieve the subject goals of physical education, appropriate teaching strategies, pedagogical design work, and learning organization procedures are necessary. The use of active learning and project-based strategy learning provides an opportunity to integrate ICT tools into the learning process. Mosston and Ashworth [67] theorize that the use of productive, indirect learning strategies supports the use of ICT tools. In guided discovery learning, learner-initiated individual programs and learner-initiated style strategies can be combined with the use of tools.

The validity of our research results is limited by the fact that the study sample was not representative but also not targeted (which is also limitation of our study); therefore, our results cannot be generalized but we obtained important results, which lays the foundations for extensive research. Another limitation of the study is the duration of the intervention and in terms of the number of PE sessions in which the app (Runtastic) was applied. Reflecting on our results, we consider it important to continue further investigations, involving more participants to ensure the representativeness of the sample.

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