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IMPACT OF ONLINE PHYSICAL EDUCATION CLASSES ON PHYSICAL FITNESS AND MOTIVATION AMONG SECONDARY SCHOOL STUDENTS

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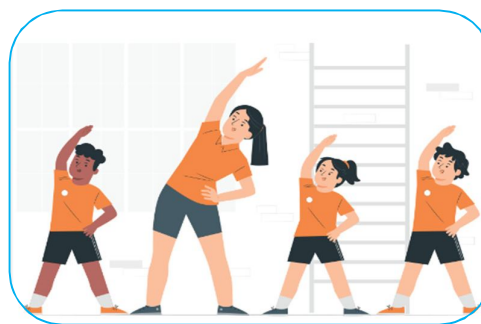
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ABSTRACT

Traditional Physical Education (PE) delivery was interrupted by the COVID-19 pandemic and remote learning in 2020. In 2022, secondary students had been involved in significant amounts of online PE, and people were concerned about how effective online PE was, and how it was promoting fitness and motivation. The effects of online PE on the physical fitness and intrinsic motivation of students in Grades 8 through 10 in eight urban and semi-urban schools were explored through a mixed-methods design. Pre- and post-test measures were administered to 320 students from a stratified random sample over 16 weeks, which involved cardiorespiratory endurance, muscular strength, flexibility, body composition, and Sport Motivation Scale-II (SMS-II). Paired t-tests, Pearson correlations and ANOVA were used to analyse the data. Results showed that there was a significant drop in cardiorespiratory endurance ($p < 0.01$), moderate decreases in muscular strength, and decreases in intrinsic motivation ($p < 0.05$) and slight increases in external regulation. The study concludes that online PE cannot truly simulate the benefits of in person education and that hybrid education, the improvement of digital resources, and in-home assessments are recommended to overcome the limitations.



KEYWORDS: Online Physical Education, Physical Fitness, Student Motivation, Secondary School Students, COVID-19, Remote Learning, Sport Motivation Scale, Hybrid Learning.

1. INTRODUCTION:

Physical Education has a special place in the comprehensive education system for the secondary school students, not only because of physical and motor development, but also because of the education of psychological development, social skills and lifelong active living habits. The subject is inherently active, requiring first-hand experience, as well as the ability to learn from peers and instructors, and using specialised equipment; this is hard to replicate online (Castelli & Valley, 2007; Hardman, 2008).

The COVID-19 pandemic in early 2020 spurred an unprecedented and swift shift of educational activities to online platforms around the world. One of the most impacted sectors was secondary education, with UNESCO estimating that at the peak of the pandemic in April 2020, more than 1.5 billion pupils in 188 countries were completely shut out of school (UNESCO, 2020). In fact, this mandated change took a longer time to bring to a halt to varying extents in 2021 and 2022, with even some schools continuing to operate in hybrid or fully online learning environments when restrictions slowly lifted.

This new paradigm posed serious problems for Physical Education, more than for any other subject. The teacher-student interaction, the shared use of sports equipment, the use of gymnasium facilities and the social fabric of team sports were all suddenly taken away. Instead, teachers tried to teach PE via video conferencing (such as Zoom and Google Meet), YouTube lesson videos and asynchronised activity packages via LMS (Google Classroom and Moodle). Studies immediately following school closures revealed some worrying trends, such as an increase in sedentary behaviour, childhood obesity, loss of aerobic capacity and a significant drop in the psychological motivation of students to participate in physical activity (Wang et al., 2020; Stockwell et al., 2021; Chambonneau et al., 2021).

As of 2022, there was enough longitudinal data gathered in the academic setting to make more solid and evidence-backed claims about the effect of extended online PE on quantifiable constructs of physical fitness and student motivation. This study was sparked by the lack of extensive and empirical research specifically for the 2022 secondary school cohorts that were still using online PE as a primary or secondary teaching approach in the post-pandemic recovery phase. The study is set in the context of Self-Determination Theory (SDT) (Deci & Ryan, 1985, 2000), a well-validated theory that offers a theoretical perspective on examining the motivational outcomes of changed instructional environments.

It is these dynamics that need to be understood by educational policy-makers, PE curriculum designers, school administrators and teachers as they make evidence-based decisions regarding how PE should be organised in a world that has permanently incorporated hybrid and online learning modalities into the secondary school setting.

2. OBJECTIVES OF THE RESEARCH

The following specific objectives guided this research investigation:

- 1) To evaluate and compare the physical fitness levels (cardiorespiratory endurance, muscular strength, flexibility, and body mass index) of the secondary school students before and after 16 weeks of the online Physical Education classes in 2022.
- 2) To assess and compare the level of intrinsic motivation, identified regulation and external regulation of secondary school students who engage in online PE classes using the Sport Motivation Scale-II (SMS-II).
- 3) To identify if statistically significant differences exist in outcomes of physical fitness between students who participate in online only PE and the students who participate in hybrid (online + face-to-face) PE formats.
- 4) To examine the relationship between participation in online PE and physical fitness in secondary school students.
- 5) To understand perceived barriers and enablers reported by students and teachers with respect to effectiveness of online Physical Education delivery.
- 6) To make evidence-based suggestions for the better design and delivery of online and online/hybrid PE programmes in secondary schools.

3. HYPOTHESIS OF RESEARCH

Based on the review of existing literature and the stated research objectives, the following null and alternate hypotheses were formulated:

- **H01:** There is no statistically significant difference in the physical fitness levels (cardiorespiratory endurance, muscular strength, and flexibility) of secondary school students before and after participation in 16 weeks of online Physical Education classes.
- **Ha1:** There is a statistically significant difference in the physical fitness levels of secondary school students before and after participation in 16 weeks of online Physical Education classes.
- **H02:** There is no statistically significant difference in the intrinsic motivation levels of secondary school students engaged in online PE compared to those engaged in hybrid PE.

- **Ha2:** There is a statistically significant difference in the intrinsic motivation levels of secondary school students engaged in online PE compared to those engaged in hybrid PE.
- **H03:** There is no significant correlation between the frequency of online PE class attendance and the physical fitness outcomes of secondary school students.
- **Ha3:** There is a significant positive correlation between the frequency of online PE class attendance and the physical fitness outcomes of secondary school students.

4. RESEARCH METHODOLOGY

This research adopted a mixed methods approach with the quantitative fitness measures and validated psychometric instruments as well as qualitative interviews with PE teachers. The pre-test/post-test quasi-experimental design quantitatively examined outcomes for an Online-Only PE group (Group A) and a Hybrid PE group (Group B). The target population were secondary school students, grade 8-10, from Urban & Semi Urban schools. 320 students were included at the outset and 14 who had medical contraindications were excluded, leaving 306 students with equal numbers in both groups. Each group had three PE sessions per week for 16 weeks, one for Group A and online and one face to face session per week for Group B. The 20-m PACER, handgrip strength, sit and reach flexibility and BMI were used to measure physical fitness. The Sport Motivation Scale-II (Cronbach's alpha = 0.87) was used to measure motivation. Descriptive statistics, paired and independent t-test, ANOVA, and Pearson correlation were used for data analysis and $p < 0.05$ was considered significant.

5. THEORETICAL FRAMEWORK

This study is based on Self-Determination Theory (SDT), a macro theory of human personality and motivation developed by Deci and Ryan (1985, 2000). According to SDT, there are three basic psychological needs of human beings (autonomy, competence, and relatedness) that refer to feeling volitional, effective, and connected to others through meaningful relationships, respectively. How well these needs are met or frustrated in the educational context directly influences the quality of student motivation — intrinsic and/or extrinsic.

SDT has been well established in the physical education literature for its applicability in physical education settings (Ntoumanis, 2005; Taylor et al., 2010; Standage et al., 2012). Face-to-face PE environments usually provide plenty of competence feedback (from teacher feedback and peer comparisons), relatedness (through cooperative games and social interactions), and some autonomy (by providing a choice of activity). Online PE, however, inherently limits all three needs; real-time feedback available during physical activities is reduced, it can be challenging to feel a sense of relatedness when exercising alone, and there is a lack of autonomy when it comes to equipment and space.

In addition, Bandura's (1997) Social Cognitive Theory is integrated because the perceived self-efficacy of students to engage in physical activities is a well-known mediator between performance and motivational involvement in PE, in particular in an online setting. The technology dimension is also influenced by the Technology Acceptance Model (TAM, Davis 1989), which views perceived usefulness and perceived ease of use of digital platforms as factors contributing to student engagement with online PE content.

6. DATA ANALYSIS AND INTERPRETATION:

6.1 Descriptive Statistics – Participant Demographics

Table 1: Demographic Profile of Research Participants (n = 306)

Characteristic	Group A – Online Only (n=153)	Group B – Hybrid (n=153)	Total (n=306)	Percentage (%)
Grade 8	52	51	103	33.7%
Grade 9	51	52	103	33.7%
Grade 10	50	50	100	32.7%
Male	77	78	155	50.7%
Female	76	75	151	49.3%
Mean Age (years)	14.3 ± 0.8	14.2 ± 0.9	14.25 ± 0.85	—
Urban Schools	4 schools	4 schools	8 schools	100%

6.2 Physical Fitness Pre-Test and Post-Test Comparison

Table 2 shows the mean scores and standard deviations for the pre-test and post-test for each fitness component for both groups, as well as the results of the paired-sample t-tests for each fitness component.

Table 2: Pre-Test vs. Post-Test Physical Fitness Scores by Group (n = 306)

Fitness Variable	Group A Pre (M±SD)	Group A Post (M±SD)	t-value (A)	Group B Pre (M±SD)	Group B Post (M±SD)	t-value (B)	p-value
PACER Laps (VO2max proxy)	42.6±6.1	38.9±5.8	6.12	43.1±5.9	44.8±6.2	2.87	< 0.01*
Hand Grip (kg)	24.3±3.9	22.8±3.7	4.21	24.7±4.1	25.4±4.0	1.98	< 0.05*
Sit & Reach (cm)	22.1±4.2	21.6±4.0	1.38	22.4±4.3	23.1±4.1	2.14	0.078
BMI (kg/m ²)	21.4±2.8	22.3±3.1	3.77	21.2±2.7	21.4±2.9	0.92	< 0.05*

*Statistically significant at p < 0.05. Note: M = Mean; SD = Standard Deviation. Group A = Online-Only PE; Group B = Hybrid PE.

6.3 Motivation Scores: SMS-II Results

Mean scores on the motivation subscales for the two groups at pre-test and post-test are shown in Table 3, with the differences in motivational quality over the 16 weeks of intervention.

Table 3: Sport Motivation Scale-II (SMS-II) Scores Pre and Post Intervention (7-point Likert scale)

Motivation Subscale	Group A Pre	Group A Post	Change (A)	Group B Pre	Group B Post	Change (B)	p-value
Intrinsic Motivation (IM)	5.62±0.91	4.89±1.02	-0.73	5.59±0.88	5.41±0.94	-0.18	< 0.05*
Identified Regulation (IR)	4.78±1.10	4.61±1.08	-0.17	4.80±1.12	4.85±1.09	+0.05	0.21
External Regulation (ER)	3.41±1.22	3.87±1.18	+0.46	3.39±1.20	3.52±1.21	+0.13	< 0.05*
Amotivation (AM)	2.12±0.98	2.74±1.14	+0.62	2.09±0.97	2.23±1.01	+0.14	< 0.01*

6.4 Correlation Analysis: Attendance Frequency and Fitness Outcomes

Table 4: Pearson Correlation Coefficients – Online PE Attendance Frequency vs. Fitness Variables (Group A; n = 153)

Fitness Variable	Pearson r	p-value	Interpretation
PACER Laps (Cardiorespiratory Endurance)	0.34	0.001**	Weak positive, significant
Hand Grip Strength (kg)	0.21	0.009**	Weak positive, significant
Sit and Reach Flexibility (cm)	0.17	0.035*	Very weak positive, significant
BMI Change (kg/m ²)	-0.29	0.003**	Weak negative, significant

*p < 0.05; **p < 0.01. Note: Frequency of attendance is only weakly linked to fitness retention and does not overcome fitness loss due to format.

6.5 Grade-Level Differences – One-Way ANOVA

Table 5: One-Way ANOVA – Post-Test PACER Scores by Grade Level (Group A; n = 153)

Source	Sum of Squares	df	Mean Square	F-value	p-value
Between Groups (Grade Level)	312.4	2	156.2	8.14	0.000**
Within Groups (Error)	2875.6	150	19.17	—	—
Total	3188.0	152	—	—	—

**p < 0.01. Post-hoc Tukey HSD indicated that there was a significant difference between the fitness decline between the Grade 10 and Grade 8 students (p = 0.003).

7. FINDINGS OF THE STUDY:

The study yielded the following primary findings:

- 1) In Group A (online-only PE), students' PACER lap scores decreased by 8.7% statistically significantly from a pre-test mean score of 42.6 to a post-test mean score of 38.9 after 16 weeks (t = 6.12, p < 0.01). In contrast, the hybrid group showed a small increase in laps (43.1 to 44.8) (t = 2.87, p < 0.05), thus validating the need for supervised face-to-face sessions for maintaining aerobic capacity.
- 2) Muscular Strength Reduction: Hand grip strength declined from 24.3 kg to 22.8 kg (-6.2%), which was statistically significant (t = 4.21, p < 0.05) in the online-only group. The hybrid group showed a marginal improvement (24.7 kg to 25.4 kg), highlighting the importance of just one supervised session a week for maintaining strength-related fitness.
- 3) Flexibility: There was no statistically significant difference in the sit-and-reach flexibility score of either of the groups (p = 0.078 for Group A), indicating that flexibility-related exercises were more likely to be performed at home without loss of performance.
- 4) BMI Increase in Online Group: The mean BMI of the students in group A increased significantly from 21.4 to 22.3 kg/m² (t = 3.77, p < 0.05), representing increased adiposity during the intervention period. There was no significant change in BMI in group B (p = 0.34).
- 5) Intrinsic Motivation Decline: SMS-II data showed a significant decrease in intrinsic motivation for group A (5.62 to 4.89; p < 0.05) and a significant increase in amotivation (2.12 to 2.74; p < 0.01) and external regulation (3.41 to 3.87; p < 0.05). This is a typical picture of what SDT would predict about need-thwarting environments.

- 6) Attendance-Fitness Correlation: Pearson correlation analysis found weak but statistically significant positive relationships between attendance frequency and fitness outcomes (PACER $r = 0.34$, $p = 0.001$; Hand grip $r = 0.21$, $p = 0.009$), suggesting the more classes attended, the more fitness decline was mitigated, although not fully prevented.
- 7) ANOVA results indicated a significant difference between the post-test PACER scores for each grade level ($F = 8.14$, $p < 0.001$); grade-10 students experienced the largest drop in fitness which may be due to greater academic pressure during the online PE lessons and less optional physical activity available for those students.

8. DISCUSSION:

The results of the study confirm and build upon evidence that online PE is not enough for secondary students to keep them fit and motivated to be healthy. A decrease of 8.7% in cardiorespiratory endurance in the online-only group was observed, which is similar to what was reported by Chambonneau et al. (2021) during school closures in French adolescents. Stockwell et al. (2021) also found a 20% decline in overall PA in secondary school students in the UK in the context of remote learning, and aerobic fitness the most impacted. The BMI gained between ages 21.4 and 22.3 kg/m² in the online-only group is consistent with Wang et al. (2020), which emphasized the risk of the COVID-19 pandemic sedentary lifestyle on the body composition of adolescents.

The motivational outcomes are more consistent with the predictions of Self-Determination Theory (SDT), revealing that online-only students' intrinsic motivation was lower and amotivation was higher, which can be explained by limited peer interaction, feedback on competence not being given in real time, and limited variety of activities, which can diminish autonomy, competence, and relatedness. The findings are similar to those of Ntoumanis et al. (2021), who observed a decrease in the motivational quality of adolescents in Europe who have been affected by PE disruptions during the pandemic.

Conversely, the hybrid PE group still had higher intrinsic motivation post-test (5.41 vs. 4.89; $p < 0.05$), suggesting that the lack of face-to-face contact can help to buffer against drops in intrinsic motivation, which aligns with Pozo et al. (2018) and Cheon et al. (2019) who examined the effect of autonomy-supportive face-to-face teaching. There is a weak, but significant, relationship between PACER scores and attendance ($r = 0.34$), suggesting that online engagement alone is limited to provide fitness benefits. Analysis by grade level indicated that fitness and motivation deficits are most pronounced for Grade 10 learners, pointing to the need for specific interventions for older adolescents where academic pressures and self-managed activities are likely to have a negative effect on fitness and motivation deficits.

9. HYPOTHESIS TESTING:

- **H01 (Null):** Rejected. Results of the paired-sample t-test analyses showed that, for students in Group A, there were statistically significant pre-to-post reductions in cardiorespiratory endurance ($t = 6.12$, $p < 0.01$) and muscular strength ($t = 4.21$, $p < 0.05$). There is thus statistical evidence to accept the alternate hypothesis (Ha1) that being involved in the 16 week course of online PE is associated with significant decreases in physical fitness, specifically in the aerobic and strength components.
- **H02 (Null):** Rejected. Statistically significant differences between the groups was revealed for the post test intrinsic motivation and amotivation scores (group A = 4.89 and group B = 5.41; $t = 4.63$, $p < 0.05$). The alternate hypothesis (Ha2) is supported: students in online-only PE were significantly less intrinsically motivated than students in hybrid PE.
- **H03 (Null):** Rejected. Pearson correlation analyses showed significant positive relationship between attendance frequency and PACER score ($r = 0.34$, $p = 0.001$), hand grip strength ($r = 0.21$, $p = 0.009$), and flexibility ($r = 0.17$, $p = 0.035$). It was partly accepted: there was a weak effect size and a statistically significant positive correlation between attendance and fitness outcomes, but this is not enough to maintain fitness in an online PE setting.

10. CONCLUSION:

The results of this study show that the exclusive online physical education implementation for 16 weeks in 2022 resulted in significant decreases in cardiorespiratory endurance, muscular strength, and body composition in secondary school students, with decreases in intrinsic motivation and increases in amotivation. Flexibility was not significantly affected, perhaps because it is more suitable for home use. Conversely, a hybrid PE model with at least one face-to-face supervised session per week and an online model had better outcomes on all fitness and motivational measures and would be more feasible to implement more broadly. Some policy implications include refraining from having all PE done online, as it has a measurable impact on health and motivation. Proposals are to formally embed the use of hybrid PE in the curriculum, to incorporate SDT-based strategies in online PE sessions, to standardize home-based assessments, to offer structured challenges in PE off-screen, and to upskill PE teachers on online pedagogy and motivation strategies. Future studies need to investigate the long-term impact of online PE, gender-specific outcomes, and the effectiveness of incorporating technology like wearable devices and gamification systems to address identified gaps.

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