



ORIGINAL SCIENTIFIC ARTICLE

THE SIGNIFICANCE OF STUDENTS' PHYSICAL ACTIVITY FOR THEIR ENGAGEMENT IN LEARNING ACTIVITIES DURING THE COVID-19 PANDEMIC

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Abstract

Study purpose. This study aims to clarify the extent to which students' physical activity is significant for their engagement in the learning process.

Materials and methods. The study sample was composed of 202 7th-10th grade students. The data collection was performed in May 2021. The research participants completed the anonymous questionnaire on an online platform. The standardized Physical Activity Questionnaire for Adolescents and the standardized Student Engagement Scale were used to assess levels of physical activity and affective and behavioural engagement.

Results. The research findings showed that students' physical activity depended on the time they participated in physical activities. The highest level of physical activity was during physical education classes. A statistically significant difference was determined in the boys' and girls' affective and behavioural engagement. The mean for the girls was higher than the mean for the boys. A statistically significant difference in the behavioural engagement of the 9th and 10th grade students was also found: 9th grade students were more engaged than 10th grade students. The multiple linear regression analysis demonstrated that gender ($\beta = 0.332$, $p < 0.0001$) and physical activity ($\beta = 0.323$, $p < 0.0001$) as predictors had a significant moderate effect on behavioural engagement.

Conclusions. The research findings reveal that although the students' physical activity was low during the COVID-19 pandemic period, this phenomenon (physical activity) still remains a predictor, which has a significant moderate effect on behavioural engagement. It was also determined that during the pandemic, the highest physical activity level of students depended mostly on obligatory physical education lessons. Thus, bearing in mind that physical education lessons were the main physical activity-enhancing measures, we would like to emphasise the importance of these lessons and their proper organisation.

Keywords: affective engagement, behavioural engagement, physical activity, physical education lessons.

Introduction

The COVID-19 pandemic has posed numerous challenges to various national systems (education, health, social and others). The changed living environments, distance learning, and social isolation during the pandemic have also had negative consequences for the general and mental health of many adolescents (Zhou et al., 2020), and for their engagement in learning (Steinmayr et al., 2020). According to researchers, one of the most important factors in changes to adolescents' health has been decreased physical activity,

as most students have been unable to attend sport clubs or actively exercise during physical education lessons (Moore et al., 2020). It may also be attributed to a transitional stage of physical and psychological development at which this age group is more sensitive to this unprecedented shift from on-site teaching to virtual classrooms (Shen et al., 2020).

Physical activity is defined as any bodily movement produced by skeletal muscles and that requires energy expenditure (NIH Consensus, 1996). It confers strong positive health benefits in youth, including positive effects on metabolic syndrome (Janssen & LeBlanc, 2010), reduction of the risk of suffering chronic illnesses, bone mineral density, weight management and obesity, as well as lower risks of cardiovascular diseases (Haynos & O'Donohue, 2012). Physical activity also has a positive effect on mental health in youth.

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There is now substantial evidence that physical activity is positively associated with production of hormones, such as endorphins, while it decreases cortisol levels and improves general mood. During this difficult period, when the number of adolescents complaining of mental problems has increased (Lei et al., 2020), physical activity can become a means of reducing stress, the state of depression, and anxiety levels of adolescents (Dsouza et al., 2020). Scientific studies show that being physically active not only reduces the symptoms of depression in adolescents, but also improves their psychological state, i.e., increases self-esteem and improves cognitive functions. The data demonstrate that life satisfaction among young people increases in proportion to the reported level of physical activity (Lojdoová et al., 2021). If physical exercise becomes a routine part of adolescents' lives, their mental health improves and depressive symptoms decrease in the long term (Biddle et al., 2019). Furthermore, recent research found that mental health benefits are only attained if a certain physical activity level is achieved (Maugeri et al., 2020).

The World Health Organization recommends a minimum of 60 minutes a day of moderate to vigorous physical activity for children aged between 5 and 17 years (Piercy et al., 2018). However, despite clear evidence of the potential benefits of being physically active, youth around the world often fail to achieve the recommended 60 minutes of moderate to vigorous physical activity per day. Research reveals that only 10 percent of children meet these recommendations for physical activity (Aubert et al., 2018).

Physical activity has clear links to students' academic achievement (Weston et al., 2020). Physical activity, especially physical education, improves classroom behaviour and benefits several aspects of academic achievement, especially mathematics-related skills, reading, and composite scores (Álvarez-Bueno et al., 2017). Studies on physical activity demonstrate that the more active adolescents are, the higher their academic achievement is, and as students' physical activity increases in leisure time, especially in moderate to vigorous intensity, their cognitive abilities improve (Rodríguez et al., 2020). Furthermore, physical activity, especially aerobic exercise, may also have a positive effect on brain structures and their functions, improving attention, processing speed and concentration capacity, and enabling the achievement of higher academic performance (Donnelly et al., 2016).

Visier-Alfonso et al. (2021) stated that students' cardiovascular state had an influence on their academic achievement. This is supported by other scientists, who claim that adolescents who regularly participate in physical activity and who are aerobically fit (Lagestad, 2019) perform better academically than those who are sedentary. Physical activity is associated with a greater cerebral blood supply; a greater volume in the frontal cortex and the hippocampus (Erickson et al., 2014). Studies indicate that physical activity increases activation in children's prefrontal cortex, which is associated with self-regulatory behaviours, when students are able to better participate in classroom lessons, and this increased engagement is a possible mechanism by which physical activity can have a positive influence on student achievement (Zan, 2013). This is based on the fact that physical activity and cognitive abilities of the student are activated by the same nervous system centres (Mavilidi et al., 2019).

Thus, the problem-based question arises: Has students' physical activity been significant for their engagement in

learning during the COVID-19 pandemic? We consider this issue as worthy of exploration as research shows that students have made less academic progress during this pandemic period compared with previous years (Renaissance Learning & Education Policy Institute, 2021). Therefore, it is important to identify factors that may influence student achievement. In this case, engagement is understood as a construct, encompassing commitment to learning, and we assess students' emotional engagement (the presence of task-facilitating emotions, such as interest) and behavioural engagement (their concentration, attention, and effort) (Reeve, 2012). Research demonstrates that engagement is a positive state of learning (energy, dedication, attention) and higher levels of student engagement are associated with higher academic achievement (Harbour et al., 2015). Moreover, adolescents' emotional engagement is related to further learning (Gutman & Schoon, 2018), psychological outcomes (self-esteem and scholastic self-esteem) (Markowitz, 2017), and a sense of being an acknowledged member of the school community (Ulmanen et al., 2016).

Materials and methods

Study participants

The selection of the research sample was carried out in two steps. The first step involved school selection. Four general education schools were selected in three municipalities of Lithuania with low-SES contexts. The second step included the selection of a grade in every school. The research sample was composed of 202 7th-10th grade students (112 girls and 90 boys). The sample distribution according to gender and grade is shown in Table 1.

Table 1. Research sample

	Girls		Boys		Total	
	n	%	n	%	n	%
7 th grade	31	27.7	18	20	49	24.3
8 th grade	30	26.8	26	28.9	56	27.7
9 th grade	20	17.8	21	23.3	41	20.3
10 th grade	31	27.7	25	27.8	56	27.7
Total	112	100	90	100	202	100

Study organization

The research was conducted in accordance with the ethical rules of the Helsinki Declaration. Oral consent from each school's principal was sought prior to the distribution of questionnaires. Informed consent was obtained from all the students and their parents or guardians. All students were informed that their responses would be treated in strictest confidence and that responses were entirely anonymous. The data collection was performed in May 2021. The research participants completed the anonymous questionnaire on the online platform <https://apklaua.lt/>. The anonymous self-report questionnaire was divided into three parts. Part I of the questionnaire collected students' basic information (gender, grade). Part II contained the Physical Activity Questionnaire for Adolescents (PAQ-A; Kowalski et al., 2004). This questionnaire was developed to assess general levels of physical activity. Each of the 9 questionnaire items

Table 2. Descriptive statistics of physical activity scores

	Girls		Boys		Total	
	Mean	SD	Mean	SD	Mean	SD
Spare-time activity: sports	1.83	0.52	2.09	0.69	1.94	0.62
Activity during physical education classes	3.40	1.07	3.91	1.00	3.59	1.05
Lunchtime activity	1.33	0.68	1.43	0.78	1.38	0.73
After-school activity	2.74	1.28	3.08	1.28	2.90	1.29
Evening activity	2.95	1.25	2.95	1.29	2.95	1.27
Weekend activity	2.99	1.15	2.98	1.23	2.98	1.18
Activity frequency over the last 7 days	2.64	1.20	2.99	1.26	2.80	1.23
Activity frequency during each day of the last week	2.90	0.96	2.82	1.05	2.86	1.00
PAQ-A total	2.40	0.62	2.54	0.69	2.46	0.66

was scored on a 5-point scale (the lowest activity response being 1 and the highest activity response being 5). The total score of the PAQ-A was calculated by adding all the average scores of the questions. Part III contained two subscales of the Student Engagement Scale (Lam et al., 2014), namely Affective Engagement and Behavioural Engagement. Each item of the subscales was rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). In this study, the internal consistency of the PAQ-A, the Affective Engagement subscale, and the Behavioural Engagement subscale was checked with Cronbach's alpha test. The Cronbach's alpha of 0.70 or higher for a set of items is considered acceptable (Cohen et al., 2018). Cronbach's alpha test showed the PAQ-A reached acceptable reliability, $\alpha = 0.891$. The findings of Cronbach's alpha suggested that the two subscales ($\alpha = 0.892$ for Affective Engagement and $\alpha = 0.831$ for Behavioural Engagement) also had an acceptable internal consistency.

Statistical analysis

The data analysis was made using IBM SPSS Statistics 26. Frequency, percentage, mean, and standard deviation were used in the descriptive procedures. Between-gender differences were assessed by Student t-tests. The difference between the 7th-10th grade students was determined by ANOVA. Statistical significance level was $p < 0.05$. Cohen's d for a Student t-test was calculated, and the effect size was examined. For Cohen's d, a value of 0.20 is interpreted as a small effect, 0.50 is a medium effect, and 0.80 is a large effect. Partial Eta squared η^2 is an effect size measured for ANOVA. Basic rules of thumb are that $\eta^2 = 0.01$ indicates a small effect; $\eta^2 = 0.06$ indicates a medium effect; $\eta^2 = 0.14$ indicates a large effect. Multiple linear regression analyses were used to examine the association of gender, 7th-10th grade, and physical activity with student affective and behavioural engagement. In regression analysis, the effect size of the predictor variables is given by the beta loadings. In interpreting the effect size gives the following guidance: 0-0.1 weak effect, 0.1-0.3 modest effect, 0.3-0.5 moderate effect, and > 0.5 strong effect (Cohen et al., 2018).

Results

Physical activity

The research findings (Table 2) showed that students' physical activity depended on the time they participated in physical activities. The highest level of physical activity was

during physical education classes. The least active periods were during the breaks between lessons. The boys' and girls' physical activity total scores were 2.54 (SD = 0.69) and 2.40 (SD = 0.62), respectively. The total score was not high either, and did not reveal a statistically significant difference ($t = 1.405$, $p = 0.162$).

The ANOVA test (Table 3) revealed that there was no statistically significant difference in the physical activity of students in different grades ($F = 2.457$, $p = 0.064$), although general levels of physical activity of the 7th-8th grade students were slightly higher than the 9th-10th grade students.

Table 3. Differences of physical activity between the 7th-10th grade students

	Mean	SD	Mean Square	ANOVA test		Partial Eta squared η^2
				F	p	
7 th grade	2.58	0.77	1.039	2.457	0.064	0.040
8 th grade	2.59	0.64				
9 th grade	2.32	0.64				
10 th grade	2.33	0.53				

Affective and behavioural engagement

Student t-tests (Table 4) reported a significant difference between lower affective engagement mean for the boys ($M = 3.15$, $SD = 0.79$) compared with the girls ($M = 3.41$, $SD = 0.73$; $t = -2.447$, $p = 0.015$). Moreover, a statistically significant difference was determined in the boys' and girls' behavioural engagement. The mean for the girls ($M = 3.56$, $SD = 0.60$) was higher than the mean for the boys ($M = 3.22$, $SD = 0.56$; $t = -4.217$, $p = 0.0001$). Finally, the Cohen's d was small for affective engagement ($d = 0.34$) and medium for behavioural engagement ($d = 0.59$).

Table 4. Student t-test findings for differences of variables in terms of gender

		Mean	SD	t-test		Cohen's d
				t	p	
Affective engagement	Boys	3.15	0.79	-2.447	0.015	0.34
	Girls	3.41	0.73			
Behavioural engagement	Boys	3.22	0.56	-4.217	0.0001	0.59
	Girls	3.56	0.60			

Comparing the affective engagement of the 7th-10th grade students, no statistically significant difference was found (Table 5). However, a statistically significant difference was

Table 5. ANOVA test findings for differences of variables in terms of 7th-10th grades

		Mean	SD	Mean Square	ANOVA test		Partial Eta squared η^2
					F	p	
Affective engagement	7 th grade	3.31	0.89	1.383	2.419	0.067	0.035
	8 th grade	3.19	0.62				
	9 th grade	3.59	0.76				
	10 th grade	3.15	0.75				
Behavioural engagement	7 th grade	3.48	0.63	1.265	3.586	0.015	0.052
	8 th grade	3.43	0.53				
	9 th grade	3.63	0.61				
	10 th grade	3.23	0.63				

Table 6. Predictions of student behavioural engagement

Predictors	Unstandardized Coefficients B	Std. Error	Standardized Coefficients β	t	p
Constant	2.473	0.170		14.566	0.0001
Physical activity	0.300	0.063	0.323	4.799	0.0001
Gender	0.407	0.082	0.332	4.936	0.0001

determined in their behavioural engagement. ANOVA with post-hoc Tukey HSD test showed a statistically significant difference in the behavioural engagement of the 9th and 10th grade students: 9th grade students ($M = 3.63$, $SD = 0.61$) were more engaged than the 10th grade students ($M = 3.23$, $SD = 0.63$; $F = 3.589$, $p = 0.015$). Nevertheless, partial Eta squared $\eta^2 = 0.052$ indicated a small effect.

The multiple linear regression analysis was implemented to determine the influence of physical activity, gender and grade on affective and behavioural engagement. It was determined that the grade was not a predictor of any engagement dimension. Having eliminated the grade and repeatedly performed a multiple linear regression analysis, it appeared that physical activity and gender were the predictors of only the students' behavioural engagement. The obtained statistically significant regression model had $R^2 = 0.20$; $F = 21.471$, $p < 0.0001$. The findings demonstrated that gender ($\beta = 0.332$, $p < 0.0001$) and physical activity ($\beta = 0.323$, $p < 0.0001$) as predictors had a significant moderate effect on behavioural engagement (Table 6).

Discussion

The findings of the study examining students' physical activity and engagement in learning during the COVID-19 pandemic enable us to highlight several important points.

Firstly, it was determined that during the COVID-19 pandemic period, the students' physical activity was low and did not depend on gender. The first trend (low physical activity) is confirmed by studies performed by other scientists in Lithuania and other countries. For example, the research by López-Sánchez et al. (2018) showed that every third child in Lithuania was physically active, whereas the decreased physical activity during the pandemic was determined by Moore et al. (2020). According to the researchers, only 2.6 percent of adolescents met the recommended guidelines of achieving 60 minutes of moderate-vigorous

physical activity per day. Moreover, the study completed by Chambonniere et al. (2021) revealed that even initially active children and adolescents decreased their physical activity more than those initially inactive and increased their sitting time during lockdowns. However, the second trend that physical activity was not dependent on gender was unexpected, as the data from the afore-mentioned study (López-Sánchez et al., 2018) showed that boys of any age group were more physically active than girls. The determined difference could probably be explained by the fundamentally changed conditions: during the COVID-19 pandemic, a lot of sports clubs / activities have closed, as well as social communication and at the same time spontaneous physical activity has been limited (e.g., skating, skateboarding, playing football, basketball, etc.). According to Hayes (2020), social communication supported by social media could have a significant effect on adolescents' physical activity; hence, it could have significantly reduced this type of activity for boys.

Secondly, the findings of the study demonstrated that during the COVID-19 pandemic, the highest levels of students' physical activity depended greatly on obligatory school physical education lessons. During the lessons, both boys' and girls' physical activity reached a higher level, and the students' physical activity became of medium or high intensity. The literature review shows that benefits associated with physical activity and fitness are not unilateral but instead are specific to the type, timing, and intensity of the physical activity. In order to ensure health and developmental benefits, it is recommended that youth should participate in a variety of enjoyable, developmentally appropriate moderate-to-vigorous physical activities for at least 60 minutes per day (Piercy et al., 2018). According to researchers (Sallis et al., 2012), obligatory school physical education is probably the most effective way to enhance engagement in physical activity for adolescents. It is suggested that positive affective experiences in physical education lessons are crucial to evoke students' intention to be physically active later

in their lives. Therefore, it is also important to pay attention to the organisation of physical activity. Physical education lessons and extracurricular activities should be organised ensuring a motivational climate, goal-oriented tasks, and evoking enjoyment. Improperly organised lessons can provoke students' anger and amotivation to be physically active (Jaakkola et al., 2019). Thus, bearing in mind that physical education lessons were one of the main and most physical activity-enhancing measures during the COVID-19 pandemic, we would like to emphasise the importance of these lessons and their proper organisation.

Thirdly, our study data suggested that the levels of students' physical activity after school, in spare time, or at weekends were low; the lowest activity level was estimated during the breaks between lessons. This means that even after spending all day sitting at a computer during distance learning, the students were not inclined to become more physically active on their own during the breaks. This identified trend is confirmed by the data collected by other scientists. For instance, Tassitano et al. (2020) argue that schools, where students spend hours each day, offer too little physical activity, especially moderate-to-vigorous physical activity. In this regard, it is justified to recommend that schools offer opportunities to be physically active before, during, and after the school day.

Finally, the fact that physical activity was important and significant for students' learning during the COVID-19 pandemic period was also demonstrated by the regression analysis of the data collected in our study. Physical activity proved to be one of the predictors for behavioural engagement. This is a very important finding of the study, which again demonstrates the role of physical activity in student learning and encourages further research into physical activity and its links to the learning process. On the other hand, we would like to draw special attention to students who are from low-SES backgrounds, as their achievements may be significantly more negatively affected by COVID-19 pandemic learning conditions compared with other students (Renaissance Learning & Education Policy Institute, 2021). The data of our study suggest that physical activity for these students (both boys and girls) would help to improve their behavioural engagement and learning outcomes. According to other studies, physical activity and academic outcomes are positively correlated in children from poorer backgrounds (Efrat, 2011). Physically active students are more engaged with their classroom lessons (Zan, 2013) and this increased engagement is a possible mechanism by which students' physical activity could have a positive influence on their academic achievement.

Conclusions

Due to the changed learning conditions during the COVID-19 pandemic, it is critical to explore the factors that have influenced student learning processes and outcomes. The findings of our study demonstrated that during this period physical activity was a predictor with a significant moderate effect on behavioural engagement. It was also determined that during the pandemic, the physical activity of students was low, and its highest levels depended mostly on obligatory physical education classes at school. We dare to claim that these are significant research findings that

emphasise the benefits of physical education lessons and the importance of physical activity to the learning process.

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Conflict of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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ЗНАЧЕННЯ ФІЗИЧНОЇ АКТИВНОСТІ УЧНІВ ДЛЯ ЇХНЬОЇ ЗАЛУЧЕНОСТІ ДО НАВЧАЛЬНОЇ ДІЯЛЬНОСТІ ПІД ЧАС ПАНДЕМІЇ COVID-19

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 6 табл., 40 джерел.

Мета дослідження. Це дослідження має на меті з'ясувати, наскільки фізична активність учнів є важливою для їхньої залученості до навчального процесу.

Матеріали та методи. Вибірку дослідження склали 202 учні 7-10 класів. Збір даних проводили в травні 2021 року. Учасники дослідження заповнили анонімну анкету на онлайн-платформі. Стандартизований Опитувальник із фізичної активності для підлітків і стандартизовану Шкалу залученості учнів використовували для оцінки рівнів фізичної активності й емоційної та поведінкової залученості.

Результати. Результати дослідження показали, що фізична активність учнів залежить від часу, який вони займалися фізичними вправами. Найвищий рівень фізичної активності був на заняттях із фізичного виховання. Визначено статистично значущу різницю в афективній та поведінковій залученості хлопців і дівчат. Середнє значення для дівчат було вищим, ніж середнє значення для хлопців. Також виявлено статистично значущу різницю в поведінковій залученості учнів 9-х і 10-х класів: учні 9-х класів були більш залученими, ніж учні 10-х класів. Множинний лінійний регресійний аналіз продемонстрував, що стать ($\beta = 0,332$, $p < 0,0001$) і фізична активність ($\beta = 0,323$, $p < 0,0001$) як предиктори мали значущий помірний вплив на поведінкову залученість.

Висновки. Результати дослідження показують, що хоча фізична активність студентів була низькою протягом періоду пандемії COVID-19, це явище (фізична активність) все ще залишається предиктором, який має значущий помірний вплив на поведінкову залученість. Також встановлено, що під час пандемії найвищий рівень фізичної активності учнів залежав

здебільшого від обов'язкових уроків фізичного виховання. Таким чином, з огляду на те, що уроки фізичного виховання були основними заходами підвищення фізичної активності, хочемо підкреслити важливість цих уроків і їх правильну організацію.

Ключові слова: афективна залученість, поведінкова залученість, фізична активність, уроки фізичного виховання.

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