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Research Article

Active Bodies, Confident Minds: Exploring the Relationship Between Physical Activity and Mathematics Self-Efficacy Among High School Students

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ABSTRACT

This study examined the relationship between physical activity and mathematics self-efficacy among high school students. Specifically, it explored how engagement in physical activity influences students' confidence in performing mathematics-related tasks. A descriptive–correlational research design was employed, involving 189 high school students from two selected schools in the Philippines. Data were collected using the Physical Activity Questionnaire for Adolescents (PAQ-A) and a Mathematics Self-Efficacy Scale. Descriptive statistics and Pearson Product–Moment Correlation were used for data analysis. Results revealed that students demonstrated a high level of physical activity ($M = 4.21$, $SD = 0.61$) and a high level of mathematics self-efficacy ($M = 3.98$, $SD = 0.64$). Furthermore, a high positive and statistically significant relationship ($r = 0.76$, $p < 0.05$) was found between physical activity and mathematics self-efficacy. These findings suggest that increased engagement in physical activity is associated with higher levels of confidence in mathematics. The study highlights the importance of promoting physical activity as part of a holistic educational approach that supports both physical and academic development. It underscores the role of schools in fostering environments that enhance students' well-being and academic self-beliefs.

Keywords: *Correlational study, High school students, Mathematics Self-efficacy, Physical activity*

Introduction

Mathematics self-efficacy refers to an individual's belief in their ability to successfully perform mathematical tasks and has consistently emerged as an important predictor of academic performance and persistence in mathematics-related activities (Zakariya, 2022). Grounded in Social Cognitive Theory, self-efficacy shapes how individuals think, feel, and behave in learning contexts (Schunk & DiBenedetto, 2015). Students with stronger mathematics self-efficacy are generally more confident when confronting complex problems, more persistent when difficulties arise, and more likely to employ effective problem-solving strategies. Rather than perceiving challenging mathematical tasks as threats to their competence, they are more inclined to approach

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them as opportunities for learning and improvement (Ningsih & Hayati, 2020). In contrast, low mathematics self-efficacy is associated with anxiety, self-doubt, and avoidance behaviors that can undermine both engagement and achievement (Hendral & Hidayati, 2023). Mathematics self-efficacy, therefore, extends beyond students' perceptions of their abilities; it can also shape how they respond to academic challenges and sustain their involvement in learning.

Although self-efficacy is commonly examined within academic contexts, its development is not exclusively determined by cognitive or instructional experiences. Cognitive, social, physiological, and affective factors can collectively contribute to the formation of efficacy beliefs. In particular, physiological and affective states, including stress, fatigue, and perceptions of physical well-being, have been recognized as relevant influences on self-efficacy (Fismasari et al., 2025; Usher et al., 2023). This broader perspective provides a basis for considering whether experiences outside conventional academic activities may also contribute to students' beliefs about their capabilities. Physical activity is particularly relevant in this regard. Although traditionally associated with cardiovascular fitness, muscular strength, and general physical well-being, its potential contributions to cognitive functioning and psychological development have received increasing attention.

Regular physical activity has been associated with cognitive processes that are important for learning, including executive functioning, attentional control, and memory (Giorgio et al., 2018). These functions are particularly relevant to mathematics, where learners must maintain attention, retain and manipulate information, reason logically, and apply appropriate strategies to solve problems. Physical activity may also support emotional regulation and reduce stress and anxiety, conditions that can influence students' readiness to engage with cognitively demanding tasks. From a neurocognitive perspective, exercise has been associated with mechanisms such as increased cerebral blood flow, neurogenesis, and neurotransmitter activity that contribute to cognitive performance and mood regulation (McMorris, 2016). These cognitive and physiological processes provide a plausible basis for considering physical activity as a factor related to students' academic experiences.

The potential relevance of physical activity extends beyond cognitive functioning to psychological constructs such as self-esteem, self-concept, and self-efficacy. Participation in physical activities can provide mastery experiences, interpersonal interaction, and feedback, all of which are relevant to the development of efficacy beliefs. Successfully performing a physical task or demonstrating improvement, for example, may strengthen perceptions of competence that could potentially extend beyond the immediate activity. Physical activity settings also create social experiences through teamwork, peer encouragement, and instructor support, which may further reinforce positive beliefs about one's capabilities (Ananayo et al., 2026; Innes et al., 2020). Viewed from this perspective, physical activity may have relevance not only to physical and cognitive development but also to the psychological processes through which students perceive and evaluate their competence.

Consistent with these potential benefits, a growing body of literature has examined physical activity in relation to academic outcomes. Evidence suggests that students who are physically active may demonstrate more favorable academic performance (Mukesh, 2015; Sullivan et al., 2017). However, much of this literature has concentrated on observable indicators of academic success, particularly grades, test scores, and overall academic achievement. Although these outcomes are important, focusing primarily on performance provides only a partial account of how physical activity may be associated with learning. Less attention has been directed toward the psychological processes underlying academic engagement, particularly students' beliefs about their capabilities within specific subject areas.

This limitation is especially relevant to mathematics, where students may experience anxiety, uncertainty, and negative perceptions of their own competence. Mathematics self-efficacy is domain-specific; consequently, a student's confidence in performing mathematical tasks cannot necessarily be inferred from general academic confidence or efficacy beliefs in other subjects. Despite the importance of this

distinction, the relationship between physical activity and mathematics self-efficacy remains comparatively underexplored. Existing research has more commonly examined general self-efficacy or broad measures of academic performance, leaving less evidence regarding whether differences in physical activity are associated with students' confidence in their mathematical capabilities.

Another limitation concerns how the relationship between physical activity and academic functioning has been conceptualized. Existing literature frequently considers physical activity in relation to academic outcomes through intervening factors such as motivation, mental health, and cognitive functioning. Such approaches provide important explanations of the pathways through which physical activity may be associated with learning. However, comparatively less attention has been given to the direct relationship between physical activity and self-efficacy within a specific academic domain. Consequently, whether students' level of physical activity is directly associated with their mathematics self-efficacy remains insufficiently understood.

Addressing this gap is particularly relevant during secondary education, a period in which students continue to develop their academic identities while simultaneously establishing behavioral and lifestyle patterns. Examining physical activity alongside mathematics self-efficacy may therefore provide a more integrated understanding of how physical, cognitive, and psychological dimensions of student development intersect. Accordingly, this study examines the relationship between physical activity and mathematics self-efficacy among secondary school students. By focusing specifically on mathematics self-efficacy rather than academic performance alone, the study seeks to extend existing evidence on the potential academic relevance of physical activity and contribute insights that may support educational approaches concerned with both students' learning and overall well-being.

Material and Methods

Research Design

This study employed a descriptive–correlational research design to examine the relationship between physical activity and mathematics self-efficacy without manipulating either variable. The descriptive component allowed the researcher to characterize the existing levels of physical activity and mathematics self-efficacy among high school students, while the correlational component was used to determine the strength and statistical significance of the relationship between the two variables.

A correlational approach was appropriate because physical activity and mathematics self-efficacy were examined as naturally occurring variables within an educational setting (Saleh et al., 2023). This design allowed patterns of association between the variables to be identified and provided a basis for determining whether students with different levels of physical activity also differed systematically in their mathematics self-efficacy. Accordingly, the analysis focused on the relationship and predictive association between physical activity and mathematics self-efficacy rather than establishing a causal effect.

Population and Sampling

The study involved 189 high school students enrolled across various grade levels in two selected high schools in the Philippines. The participating schools were purposively selected based on their accessibility, diversity of their student populations, and representation of typical secondary school settings within the Philippine educational context.

Following the identification of the participating schools, simple random sampling was employed to select students from the eligible population. Through this probability-based approach, each eligible student within the identified population had an equal opportunity to be selected for participation, thereby reducing potential selection bias (Latpate et al., 2021). The sampling procedure resulted in a final sample of 189 students representing different grade levels across the two participating high schools.

Procedure

Prior to data collection, formal permission to conduct the study was sought from the administrators of the selected high schools. Following approval, the researchers coordinated with the appropriate school officials and teach-

ers to facilitate the administration of the research instruments. Before participation, students were informed about the purpose and procedures of the study, the voluntary nature of their involvement, and their right to withdraw at any point without penalty. Informed consent was obtained from all participants, with parental or guardian consent additionally secured for those who were minors in accordance with established ethical requirements.

The survey was administered through face-to-face and online modalities to accommodate differences in accessibility and scheduling. Of the 189 respondents, 122 (64.55%) completed the survey face-to-face and 67 (35.45%) completed it online. Face-to-face data collection was conducted during scheduled sessions on the school premises, where participants were given adequate time to complete the questionnaires independently. For online administration, the same instruments were distributed through a secure digital platform with clear instructions for completion. To maintain consistency across modalities, the instruments were presented using the same item sequence, response options, and administration instructions.

An independent-samples *t*-test comparing responses obtained through the two administration modalities was not conducted. Thus, the study cannot empirically establish whether physical activity and mathematics self-efficacy scores were equivalent between respondents who completed the questionnaires face-to-face and those who participated online. To minimize potential procedural differences, however, the researchers maintained standardized instructions and identical versions of the instruments across both modes of administration.

Confidentiality, anonymity, and privacy were maintained throughout the data collection process. Participants were assured that their responses would be used solely for research purposes, and no personally identifiable information was included in the dataset used for analysis. All collected information was handled in accordance with established ethical research procedures.

Upon completion of data collection, responses from both administration modalities were retrieved and screened for completeness and accuracy. Eligible responses were then consolidated, coded, and organized for subsequent statistical analysis.

Instrument

The study employed standardized and validated instruments to assess the participants' physical activity and mathematics self-efficacy. Physical activity was measured using the Physical Activity Questionnaire for Adolescents (PAQ-A), a self-administered instrument that estimates adolescents' general physical activity during the preceding seven days. The PAQ-A captures activity across several contexts, including leisure time, physical education classes, school break and lunch periods, after-school hours, evenings, and weekends. Item 1 records the frequency of participation in various leisure-time physical activities, such as walking, bicycling, jogging or running, swimming, badminton, volleyball, and basketball. Items 2–5 assess activity during PE classes, breaktime, lunchtime, and immediately after school, whereas Items 6–8 address activity during evenings and weekends and the participant's overall pattern of physical activity during the previous seven days. Item 9 captures the frequency of physical activity for each day of the preceding week, from Monday through Sunday.

Items 1–9 were included in the computation of the composite PAQ-A score. Each item was scored from 1 to 5, with higher values indicating greater physical activity. For Item 1, scores corresponding to the reported frequency of participation in the listed leisure-time activities were averaged to produce a single item score. Items 2–8 were assigned scores from 1 to 5 based on the response selected by the participant. For Item 9, the daily activity scores from Monday through Sunday were averaged to generate a single score for the item. The nine resulting item scores were then summed and divided by nine, yielding an overall PAQ-A score ranging from 1 to 5. Higher composite scores represented greater overall physical activity during the seven-day recall period. Items 10 and 11, which identify whether illness or other circumstances restricted the participant's usual physical activity and specify the reason for such restriction, were not included in the composite score. Previous research has demonstrated acceptable to

high internal consistency for the PAQ-A among adolescent populations, with Cronbach's alpha coefficients ranging from α = 0.70 to 0.90 (Kuanysh et al., 2025; Qin et al., 2024; Regaieg et al., 2016).

Mathematics self-efficacy was measured using the Mathematics Self-Efficacy Scale developed by Nugraha and Umam (2023). The instrument comprises 28 statements designed to assess students' beliefs about their capabilities in mathematics learning, including their perceived ability to engage in and successfully accomplish mathematics-related learning tasks. It contains both positively and negatively worded statements. The version adopted for the present study was already available in English and was administered in English; consequently, translation into Tagalog was not necessary. Responses were recorded using a five-point Likert-type scale. Negatively worded statements were reverse-scored where appropriate so that higher composite scores consistently reflected stronger mathematics self-efficacy.

The Mathematics Self-Efficacy Scale had undergone a systematic development and validation process in the original study, including expert evaluation, individual and small-group testing, and field testing. Nugraha and Umam (2023) reported evidence supporting the validity and reliability of the instrument for measuring students' mathematics self-efficacy. To establish its suitability for the context and participants of the present study, the English version was further evaluated by subject-matter experts for item clarity, relevance, and contextual appropriateness. A pilot test was subsequently conducted to examine item comprehensibility and internal consistency. The pilot testing yielded a Cronbach's alpha coefficient greater than 0.85, indicating high internal consistency and providing further support for the reliability of the instrument in the present study.

Data Analysis

The data gathered in this study were systematically encoded, tabulated, and analyzed using appropriate statistical tools to generate meaningful interpretations. Descriptive statistics, specifically the weighted mean and standard deviation, were employed to determine the levels of physical activity and mathematics self-efficacy among the respondents. In addition, frequency and percentage distribution were used to present the demographic profile of the participants. To examine the relationship between physical activity level and mathematics self-efficacy, the Pearson Product–Moment Correlation Coefficient was utilized to determine the strength and direction of the association between the variables. All statistical analyses were conducted at a 0.05 level of significance, ensuring that the findings are statistically valid and reliable.

Result and Discussion

As presented in Table I, the majority of respondents (63.49%) demonstrated a high level of physical activity, while 25.93% exhibited moderate levels and only 10.58% fell under the low category. The overall mean of 4.21 (SD = 0.61) confirms that students, on average, exhibit a high level of physical activity.

Table 1. Descriptive Statistics on the Physical Activity Levels Among the Respondents

Physical Activity Level	Frequency (f)	Percentage (%)	Mean	SD
Low	20	10.58%	2.35	0.30
Moderate	49	25.93%	3.58	0.27
High	120	63.49%	4.62	0.28
Overall	189	100%	4.21	0.61

On the other hand, table II shows that the majority of respondents (58.20%) reported a high level of mathematics self-efficacy, with an overall mean of 3.98 (SD = 0.64). This indicates that students generally possess strong confidence in their ability to perform mathematics-related tasks.

Table 2. Descriptive Statistics on the Self-Efficacy in Mathematics Among the Respondents

Mathematics Self-Efficacy Level	Frequency (f)	Percentage (%)	Mean	SD
Low	15	7.94%	2.31	0.30
Moderate	64	33.86%	3.52	0.25
High	110	58.20%	4.52	0.31
Overall	189	100%	3.98	0.64

Finally, Table III reveals a high positive correlation ($r = 0.76$, $p < 0.05$) between physical activity level and mathematics self-efficacy. This indicates that students who engage in higher levels of physical activity tend to exhibit significantly greater confidence in their mathematical abilities.

Table 3. Correlation Matrix Between Physical Activity and Mathematics Self-Efficacy

Variables	Pearson r	Interpretation	p-value	Significance
Physical Activity & Mathematics Self-Efficacy	0.76	High Positive Correlation	0.001	Significant

Discussions

The findings indicate that the majority of respondents demonstrated a high level of physical activity, suggesting that regular movement and participation in physical activities were common among the students surveyed. This pattern may be associated with opportunities for physical activity provided through structured physical education programs, sports participation, and health- and fitness-related experiences within the school environment. The high overall mean similarly indicates that physical activity was relatively prevalent among the respondents during the period assessed by the study (Coşkun & Özer, 2018).

This pattern is consistent with literature associating regular physical activity with favorable cognitive functioning, emotional well-being, and overall health (Lu & Yu, 2023; Yalçin & Yilmaz, 2023). Physically active students have also been associated with characteristics relevant to academic engagement, including concentration, discipline, and resilience. Environmental conditions may likewise be relevant, as access to facilities and organized opportunities for participation can support students' engagement in physical activity (Fern et al., 2017). However, given the cross-sectional nature of the present study, these factors should be regarded as possible contextual explanations rather than causes of the observed physical activity levels.

The respondents also demonstrated a high level of mathematics self-efficacy. This finding is consistent with Bandura's (1997) theoretical position that self-efficacy is closely related to individuals' motivation, persistence, and responses to challenging tasks. Within mathematics learning, students who report stronger self-efficacy may be more willing to approach difficult tasks, sustain effort when difficulties arise, and remain engaged in problem-solving activities.

This interpretation is supported by studies associating higher mathematics self-efficacy with greater academic engagement, persistence, and effective problem-solving behaviors (Siregar et al., 2023; Yu et al., 2023). Students with stronger efficacy beliefs tend to approach challenging mathematical tasks with greater confidence and maintain their efforts despite difficulties. Such beliefs may coexist with positive learning experiences, effective instructional practices, and supportive academic environments (Street et al., 2017; Zhang, 2023). Nevertheless, the present findings do not establish which factors produced the students' mathematics self-efficacy, as these potential influences were not examined directly.

More importantly, the results revealed a significant positive relationship between physical activity and mathematics self-efficacy, indicating that students who reported higher levels of physical activity also tended to report greater confidence in their mathematical capabilities. This association is compatible with previous research linking physical activity with cognitive processes such as attention, memory, and executive control, which are relevant to mathematics learning (Dapp & Roebers, 2019; Have et al., 2018; Loturco et al., 2022). These cognitive processes may provide one possible

context for understanding the observed relationship; however, the present cross-sectional correlational design does not establish that physical activity produced improvements in cognitive functioning or mathematics self-efficacy.

The observed relationship can also be considered within Bandura's Social Cognitive Theory (1997), which recognizes physiological and affective states as relevant to individuals' efficacy beliefs. Previous research has associated physical activity with lower anxiety, more favorable affective states, and experiences of mastery (Sriramatr et al., 2016). Such characteristics may be related to stronger self-efficacy, but the direction of the relationship cannot be determined from the present findings. It is equally plausible that students with stronger self-efficacy, greater self-regulation, or greater confidence in their capabilities may be more inclined to participate regularly in physical activities. The association may therefore reflect bidirectional processes or shared underlying characteristics rather than a direct effect of physical activity on mathematics self-efficacy.

The strong correlation observed in the study is likewise consistent with literature examining relationships between physical self-concept and academic self-beliefs (Latino et al., 2023; Sneck et al., 2019). Rather than indicating that improvement in one domain necessarily causes improvement in another, the present findings suggest that physical engagement and positive academic self-beliefs may coexist and potentially interact within students' broader developmental experiences. Students who demonstrate greater confidence, persistence, self-regulation, or discipline in one area may exhibit similar tendencies across other areas of their lives. Conversely, positive experiences across physical and academic contexts may contribute to mutually reinforcing perceptions of competence. These possible explanations warrant further investigation using longitudinal or experimental designs capable of examining temporal and causal relationships.

The relationship should also be interpreted in recognition of the multiple factors associated with mathematics self-efficacy. Prior achievement, instructional quality, social support, and other individual and contextual characteristics may contribute to students' efficacy beliefs (Vazou & Skrade, 2017). Physical activity should therefore not be regarded as an independent or exclusive determinant of mathematics self-efficacy. Instead, the significant association identified in the present study positions physical activity as one factor that co-occurs with mathematics self-efficacy within a broader network of academic, behavioral, psychological, and contextual influences.

Overall, the findings contribute to the growing literature supporting a holistic perspective on student development, in which physical, cognitive, and psychological dimensions are interconnected. The significant relationship between physical activity and mathematics self-efficacy suggests that students' physical and academic experiences should not necessarily be viewed as isolated domains. Although the present study cannot conclude that increasing physical activity will directly improve mathematics self-efficacy or academic outcomes, the observed association provides a basis for further investigation of how physical activity, academic self-beliefs, and related individual and contextual factors interact over time. Longitudinal and experimental research would be particularly valuable for clarifying the direction and mechanisms underlying this relationship.

Conclusion

The study concludes that the respondents demonstrated high levels of both physical activity and mathematics self-efficacy, indicating that they were generally engaged in physical activities and reported strong confidence in their capabilities in mathematics. More importantly, a statistically significant positive relationship was observed between the two variables, indicating that students with higher levels of physical activity also tended to report higher mathematics self-efficacy. This finding establishes an association between physical activity and mathematics self-efficacy within the population examined but does not demonstrate that either variable causes changes in the other.

The observed relationship underscores the relevance of considering students' physical and academic experiences within a broader perspective of holistic development. Although the findings do not establish that participation in physical activity directly improves mathemat-

ics self-efficacy, they suggest that physical activity and positive academic self-beliefs may coexist as interconnected dimensions of students' educational experiences. The relationship may also operate bidirectionally or reflect other individual, behavioral, or contextual factors that were not examined in the present study.

In light of these findings, educational institutions are encouraged to continue providing meaningful opportunities for students to participate in regular physical activity through physical education, sports, and recreational programs as part of broader efforts to support student health and well-being. At the same time, mathematics instruction may incorporate strategies that foster students' confidence, persistence, and positive beliefs about their mathematical capabilities. These initiatives should be regarded as complementary components of holistic student development rather than assuming that increased physical activity will directly produce improvements in mathematics self-efficacy.

Future studies may employ longitudinal or experimental designs to clarify the direction and potential mechanisms underlying the relationship between physical activity and mathematics self-efficacy. Further research may also examine variables that could explain or influence this association, including teaching strategies, motivation, prior academic achievement, self-regulation, and learning environments. Expanding the investigation to more diverse student populations and incorporating objective measures of physical activity may further strengthen the generalizability and methodological rigor of future research.

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