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Predicting Physical Education Achievement: The Role of Sports Extracurricular Activeness, Motivation, Discipline, and Responsibility

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ABSTRACT

Purpose of the study: This study examines the individual and simultaneous relationships of sports extracurricular activeness, learning motivation, discipline, and responsibility with physical education achievement among eleventh-grade Science Track students at State Senior High School 1 Grobogan, Central Java, Indonesia.

Methodology: A quantitative correlational cross-sectional design was employed with 84 eleventh-grade Science Track students selected via proportionate random sampling from a population of 112. Data were collected using four validated five-point Likert-scale questionnaires and official semester report card grades. Prerequisite assumption tests and multiple linear regression analysis were conducted using IBM SPSS Statistics Version 21.0.

Main Findings: All four variables showed significant positive relationships with physical education achievement. Discipline demonstrated the strongest individual correlation ($r = 0.833$), followed by responsibility ($r = 0.796$), extracurricular activeness ($r = 0.789$), and learning motivation ($r = 0.677$). Simultaneous regression analysis confirmed that the four variables collectively explained 90.6% of achievement variance ($R^2 = 0.906$, $F(4,79) = 190.987$, $p < 0.001$), with responsibility yielding the highest effective contribution (27.6%).

Novelty/Originality of this study: This study is the first to simultaneously examine sports extracurricular activeness, learning motivation, discipline, and responsibility as combined predictors of physical education achievement among Indonesian senior high school students within a single regression model, identifying responsibility as the dominant behavioral determinant and demonstrating the collective predictive power of affective and extracurricular variables.

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1. INTRODUCTION

Physical education, sports, and health occupies a unique and irreplaceable position within the Indonesian secondary school curriculum [1]. Unlike purely cognitive disciplines, physical education simultaneously cultivates students' psychomotor, affective, and cognitive domains through systematic, guided physical activities [2], [3]. The success of this multidimensional learning process is ultimately reflected in students' learning achievement, a composite measure encompassing skill mastery, knowledge acquisition, and behavioral attitudinal change [4]. Understanding the factors that drive or constrain this achievement is therefore a matter of both theoretical and practical significance [5]-[7].

Globally, research consistently demonstrates that academic achievement in physical education is not a simple product of innate athletic talent but rather reflects a confluence of motivational, behavioral, and contextual variables [8]. The ecological model of youth sport participation posits that students engage in physical activities to the extent that individual factors (intrinsic motivation, perceived competence), social factors (peer and family support), and institutional factors (school climate, extracurricular opportunities) align to create enabling conditions for learning and performance [9], [10]. Within the Indonesian educational context, where physical education remains a mandatory subject with standardized minimum competency thresholds, this multi-factor understanding is especially pertinent [11], [12].

Extracurricular sport activities represent one of the most significant institutional mechanisms through which schools can extend and deepen students' physical education experiences [13]. According to the Indonesian Ministry of Education and Culture's guidelines, extracurricular programs serve developmental, social, recreational, and career-preparatory functions. Empirical research supports the notion that active participation in sport extracurricular activities provides students with additional practice hours, peer learning opportunities, and motivational reinforcement that synergistically enhance their formal classroom physical education performance [14], [15].

Learning motivation constitutes a central construct in educational psychology, broadly defined as the internal force that energizes, directs, and sustains purposeful learning behavior toward desired outcomes [16], [17], [18]. Within physical education, motivation is particularly salient because engagement is physically observable and performance is immediately measurable [19]. The Self-Determination Theory (SDT) framework [20] distinguishes between intrinsic motivation driven by inherent interest and enjoyment and extrinsic motivation driven by external rewards or pressures, with intrinsic motivation consistently predicting superior learning outcomes including physical education achievement [21].

Academic discipline, understood as the degree to which students voluntarily adhere to learning norms, manage their time responsibly, and maintain orderly study habits [22], constitutes a critical but often underexamined predictor of physical education achievement. Discipline functions as a prerequisite for the kind of consistent, effortful practice that underpins skill acquisition in physical activities [23], [24]. Students who demonstrate high discipline are better positioned to exploit every minute of both formal physical education classes and extracurricular sessions, compounding their learning over time.

Personal responsibility, the willingness to fully assume obligations and accept consequences of one's actions adds a further dimension to the achievement equation [25]. In the educational context, responsible students approach their learning duties with internal accountability, persist through challenges, and maintain engagement even without external coercion. This internalized sense of duty closely aligns with autonomous motivation in the SDT framework, theoretically linking responsibility to intrinsic motivation and, transitively, to superior performance outcomes [26], [27].

Although previous studies have investigated the effects of extracurricular participation, learning motivation, discipline, and responsibility on educational outcomes, most have examined these variables separately or in limited combinations. Furthermore, empirical evidence focusing specifically on physical education achievement among Indonesian secondary school students remains scarce. This gap is particularly consequential given Indonesia's ongoing curriculum reform agenda under the Merdeka Belajar framework, which increasingly emphasizes holistic student development integrating cognitive, affective, and psychomotor domains, making evidence-based identification of physical education achievement predictors an urgent policy priority for teachers, school administrators, and policymakers seeking to develop more effective educational and extracurricular programs.

The present study was conducted at at State Senior High School 1 Grobogan, Central Java, Indonesia, a public senior high school with active sports extracurricular programs and diverse student participation in physical education activities. This setting provides an appropriate context for examining how motivational, behavioral, and extracurricular factors contribute to students' physical education achievement. Unlike previous studies that examined extracurricular participation, motivation, discipline, or responsibility in isolation, this study simultaneously integrates all four variables within a single multiple regression model, providing the first comprehensive predictive analysis of physical education achievement among Indonesian senior high school students.

Therefore, this study aims to examine the individual and simultaneous relationships of sports extracurricular activeness, learning motivation, discipline, and responsibility with physical education achievement among eleventh-grade Science Track students at at State Senior High School 1 Grobogan, Central Java, Indonesia.

2. RESEARCH METHOD

2.1 Research Design

This study employed a quantitative correlational research design to examine the individual and simultaneous relationships between sports extracurricular activeness, learning motivation, discipline, and

responsibility as predictor variables, and physical education achievement as the criterion variable. A correlational design was selected because the study sought to identify the direction, magnitude, and relative contribution of multiple predictor variables to a single outcome variable without experimental manipulation of any variable. This design is well-suited to educational research contexts in which the variables of interest are naturally occurring attributes of students that cannot ethically or practically be assigned or controlled. The study adopted a cross-sectional survey approach, with all data collected during the first semester of the 2024/2025 academic year.

2.2 Population and Sample

The study was conducted at State Senior High School 1 Grobogan, Grobogan Regency, Central Java, Indonesia. The target population consisted of all 112 eleventh-grade students enrolled in the Science Track during the 2024/2025 academic year. This curricular stream was selected purposively because it represents an academically rigorous and homogeneous student population in which the interplay between extracurricular sports participation and academic achievement is particularly salient.

A total of 84 students were selected through proportionate random sampling, representing 75% of the target population, based on the Krejcie and Morgan sample size table [28]. To be included in the study, participants were required to be actively enrolled in the Science Track and to complete all questionnaire items. Only fully completed questionnaires were retained for analysis, and no exclusions were ultimately necessary. The number of participants drawn from each class was determined using the proportional allocation formula presented in Equation 1, where n_i denotes the sample size from class i, N_i denotes the population size in class i, N denotes the total population (112), and n denotes the total sample size (84).

$$n_i = \frac{N_i}{N} xn \quad \ldots (1)$$

Applying this formula across all six Science Track classes yielded fractional values ranging from 13.50 to 14.25, which were rounded to 14 students per class to achieve the targeted total sample of 84 participants. The complete population and sample distribution by class is presented in Table 1.

Table 1. Population and Sample Distribution by Class

Class	Population (N)	Percentage (%)	Sample (n)
XI Science 1	19	16.96	14
XI Science 2	18	16.07	14
XI Science 3	19	16.96	14
XI Science 4	18	16.07	14
XI Science 5	19	16.96	14
XI Science 6	19	16.96	14
Total	112	100.00	84

As shown in Table 1, the sample was distributed as near-equally as possible across all six classes, with 14 students selected from each classroom group. Although minor differences in class size existed, the proportional allocation formula produced values sufficiently close to warrant equal allocation, which simplified random selection while maintaining adequate representation across all groups. Following proportional allocation, students within each class were randomly selected using the class attendance list as the sampling frame, ensuring that all students had an equal probability of selection. The overall sampling procedure, from population to final sample, is illustrated in Figure 1.

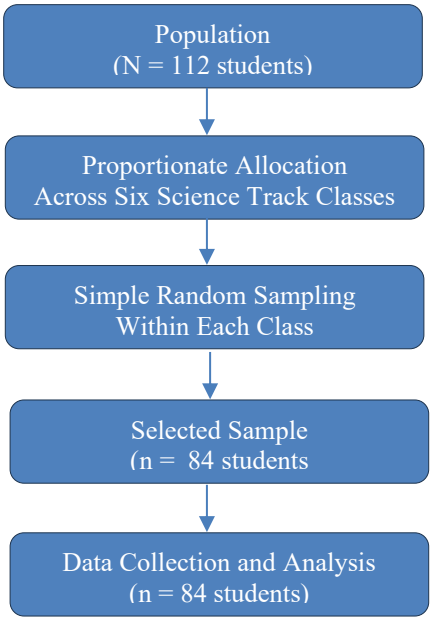

Figure 1. Sampling Procedure

As illustrated in Figure 1, the sampling procedure comprised four sequential stages: identification of the total population, proportionate allocation across six Science Track classes, simple random sampling within each class, and final selection of the study sample. This multi-stage procedure ensured that the selected sample was both statistically representative of the target population and methodologically transparent, thereby supporting the reproducibility of the study.

2.3 Data Collection Technique

Data were collected using five instruments: four validated Likert-scale questionnaires measuring the independent variables and official semester report card grades representing the dependent variable. All questionnaires employed a five-point Likert response scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The Extracurricular Activeness Questionnaire (X_1) consisted of 18 items designed to assess students' frequency of participation, level of active involvement, and quality of engagement in sports extracurricular activities. The Learning Motivation Questionnaire (X_2) comprised 15 items measuring intrinsic motivation, goal orientation, persistence, interest, and perceived reward within the physical education context. The Discipline Questionnaire (X_3) included 14 items covering three dimensions: temporal discipline (time management and punctuality), spatial discipline (readiness and preparation), and normative discipline (compliance with institutional rules and expectations). The Responsibility Questionnaire (X_4) consisted of 14 items assessing students' diligence, perseverance, task completion, and self-regulated learning behavior, developed with reference to the personal responsibility measurement framework proposed by Ref [29].

Physical Education Achievement (Y) was operationalized using students' official end-of-semester report card grades in Physical Education, Sports, and Health. These grades reflect performance across cognitive, psychomotor, and affective domains as defined by the school curriculum, with final scores ranging from 0 to 100. A summary of all research instruments is presented in Table 2.

Table 2. Research Instrument Summary

Variable	Instrument	Items	α	Dimensions/Indicators
X_1 Extracurricular Activeness	Questionnaire	18	0.900	Attendance frequency, active participation, engagement quality
X_2 Learning Motivation	Questionnaire	15	0.908	Intrinsic drive, goal orientation, persistence, interest, perceived reward
X_3 Discipline	Questionnaire	14	0.892	Temporal, spatial, normative discipline
X_4 Responsibility	Questionnaire	14	0.906	Diligence, tenacity, task completion, self-directed learning
Y Physical Education Achievement	Report card grades	—	—	Cognitive, psychomotor, affective domains (score 0–100)

As presented in Table 2, instrument validation was conducted using 30 pilot respondents from the same school who were excluded from the main study sample. Item validity was assessed using Pearson's product-

moment correlation. Items were considered valid if the correlation coefficient exceeded the r-table value of 0.361 at df = 28 and α = 0.05. All items across the four questionnaires met this criterion and were retained for the main study.

Instrument reliability was assessed using Cronbach's alpha coefficient. All instruments demonstrated good to excellent internal consistency, with alpha values ranging from 0.892 to 0.908, exceeding the recommended threshold of α = 0.70, indicating high reliability across all four instruments.

2.4 Data Analysis Technique

All data were analyzed using IBM SPSS Statistics Version 21.0. The analysis was conducted in three sequential stages: descriptive statistics, regression assumption testing, and hypothesis testing.

Descriptive statistics, including mean, standard deviation, minimum, and maximum values, were computed for all five research variables to describe the distributional characteristics of the data prior to inferential analysis.

Before conducting hypothesis testing, several regression assumption tests were performed to verify the appropriateness of multiple linear regression analysis. The normality of residuals was tested using the Kolmogorov–Smirnov test, which indicated that the residuals were normally distributed (K–S Z = 0.810, p = 0.528). Homoscedasticity was examined using the Glejser test, and all predictor variables showed significance values greater than 0.05, indicating that heteroscedasticity was not present. Multicollinearity was assessed using the Variance Inflation Factor, and all VIF values were below 10, indicating no serious multicollinearity among the independent variables. Linearity was evaluated using the Lagrange Multiplier test, which confirmed a linear relationship between the predictors and the dependent variable (χ^2 = 0.559, p > 0.05). Overall, all regression assumptions for multiple linear regression were satisfied.

Hypothesis testing was conducted at a significance level of α = 0.05. The individual relationships between each independent variable and physical education achievement were examined using Pearson's product-moment correlation. The simultaneous effect of all independent variables on physical education achievement was analyzed using multiple linear regression.

The coefficient of determination (R^2) was used to determine the proportion of variance in physical education achievement explained jointly by the independent variables. Furthermore, to examine the contribution of each predictor, both effective contribution (SE%) and relative contribution (SR%) were calculated. The effective contribution represents the absolute contribution of each predictor to the total explained variance, while the relative contribution indicates the proportional contribution of each predictor relative to the total R^2.

2.6 Ethical Considerations

This study was conducted in accordance with ethical principles governing educational research involving human participants. Prior to data collection, written permission was obtained from the principal of State Senior High School 1 Grobogan. All student participants were informed of the study's purpose, the voluntary nature of their participation, and their right to withdraw at any point without consequence. Participant anonymity was maintained throughout data collection, analysis, and reporting by using numerical codes rather than personal identifiers. No personally identifiable information was recorded or retained beyond the duration of the study. As this study did not involve clinical procedures, deception, or vulnerable populations beyond the standard educational research context, formal ethics committee review was not required under the applicable institutional guidelines.

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistics

The sample consisted of 84 eleventh-grade Science Track students (N = 84). Table 3 presents descriptive statistics for all research variables.

Table 3. Descriptive Statistics of Research Variables

Variable	N	Min	Max	Mean	SD
Extracurricular Activeness (X1)	84	37	85	60.18	10.09
Learning Motivation (X2)	84	32	71	50.32	8.27
Discipline (X3)	84	28	70	46.61	8.23
Responsibility (X4)	84	33	62	45.65	6.98
Sports Learning Achievement (Y)	84	67	97	85.32	6.87

Note. SD = Standard Deviation. All scores reflect questionnaire totals except Physical Education Achievement, which represents the official report card grade.

The distribution of extracurricular activeness scores indicated that the majority of students (32.1%) scored in the 47–56 range, suggesting moderate activeness. Learning motivation was similarly distributed, with 35.7% of students scoring 48–55. Discipline scores clustered in the 37–44 range (38.1%), while responsibility centered

around 39–44 (33.3%). Physical education achievement was skewed higher, with 40.5% of students scoring 85–90. These distributions suggest that while psychological-behavioral factors remain at moderate levels, physical education achievement is generally satisfactory, supporting the notion that additional factors drive achievement variance.

3.2 Regression Assumption Test Results

The Kolmogorov–Smirnov normality test yielded Z = 0.810 (p = 0.528), confirming that unstandardized residuals from the regression model are normally distributed. The Glejser test showed all independent variables produced non-significant results (p > 0.05), confirming the absence of heteroscedasticity. Multicollinearity diagnostics revealed tolerance values for $X_1 = 0.478$, $X_2 = 0.616$, $X_3 = 0.399$, and $X_4 = 0.435$, with corresponding VIF values of 2.093, 1.625, 2.505, and 2.301 respectively, all well below the critical threshold of 10. The Lagrange Multiplier linearity test produced $\chi^2 = 0.559$, substantially below the critical value (χ^2table = 106.6 at $\alpha = 0.05$), confirming that a linear model specification is appropriate. All regression assumptions were satisfactorily met.

3.3 Individual Relationships: Pearson Correlation Results

Table 4 summarizes the results of Pearson's product-moment correlation analyses for all four individual hypotheses.

Table 4. Product Moment Correlation Results

Variable Relationship	r	p-value	Conclusion
Extracurricular Activeness → Achievement	0.789	0.000	Positive & Significant
Learning Motivation → Achievement	0.677	0.000	Positive & Significant
Discipline → Achievement	0.833	0.000	Positive & Significant
Responsibility → Achievement	0.796	0.000	Positive & Significant
All Variables (Multiple) → Achievement	0.952	0.000	Positive & Significant

Note. All correlations significant at p < 0.001 (two-tailed). N = 84.

Discipline demonstrated the strongest individual association with physical education achievement (r = 0.833), followed by responsibility (r = 0.796), extracurricular activeness (r = 0.789), and learning motivation (r = 0.677). All relationships are positive and highly significant, fully supporting Hypotheses 1 through 4.

3.4 Simultaneous Relationships: Multiple Regression Results

Table 5 presents the multiple regression coefficients and effective contributions of each predictor variable.

Table 5. Multiple Regression Analysis Results

Predictor	B	Std. Error	Beta (β)	Effective Contribution	Predictor
(Constant)	36.369	1.868	–	–	(Constant)
Extracurricular Activeness (X1)	0.176	0.034	0.258	20.4%	Extracurricular Activeness (X1)
Learning Motivation (X2)	0.236	0.036	0.284	19.2%	Learning Motivation (X2)
Discipline (X3)	0.235	0.046	0.282	23.5%	Discipline (X3)
Responsibility (X4)	0.341	0.051	0.346	27.6%	Responsibility (X4)
Total $R^2 = 0.906$; F = 190.987; p < 0.001				90.6%	Total $R^2 = 0.906$; F = 190.987; p < 0.001

Note. Dependent variable: Physical education Achievement (Y). R = 0.952; $R^2 = 0.906$; Adjusted $R^2 = 0.902$; F(4,79) = 190.987; p < 0.001.

The multiple correlation coefficient R = 0.952 indicates an exceptionally strong combined relationship between the four predictors and physical education achievement. The coefficient of determination $R^2 = 0.906$ reveals that the four variables collectively explain 90.6% of the variance in physical education achievement, leaving only 9.4% attributable to factors outside this model. The overall model was statistically significant (F(4,79) = 190.987, p < 0.001). The regression equation is:

$$Y = 36.369 + 0.176X_1 + 0.236X_2 + 0.235X_3 + 0.341X_4 \ldots (2)$$

All regression coefficients are positive and statistically significant (all p < 0.001). Responsibility demonstrated the largest standardized coefficient (β = 0.346) and highest effective contribution (27.6%), followed by discipline (β = 0.282; 23.5%), extracurricular activeness (β = 0.258; 20.4%), and learning motivation (β = 0.284; 19.2%).

3.5 Extracurricular Activeness and PE Achievement

The significant positive relationship between extracurricular sport activeness and PE achievement (r = 0.789) corroborates extant literature on the academic and psychomotor benefits of co-curricular sport engagement.

Supplementary practice through extracurricular participation extends students' motor learning time, providing opportunities to consolidate skills introduced in formal physical education classes and to develop tactical understanding of specific sports. This finding aligns with the position of Mogonea (2023) that extracurricular activities are not peripheral to formal curriculum but are integral to developing the competencies assessed in PE subjects [30].

From the perspective of sport pedagogy, the effective contribution of extracurricular activeness (20.4%) underscores the value of schools investing in structured, diverse extracurricular sport programs. The principle of deliberate practice, extended engagement in specific sport activities precisely what extracurricular programs offer is a fundamental driver of skill mastery and, by extension, academic performance in physical education [31], [32]. Schools should therefore view extracurricular sport not merely as recreational enrichment but as a pedagogically sound extension of formal physical education instruction.

3.6 Learning Motivation and PE Achievement

The significant positive correlation between learning motivation and PE achievement ($r = 0.677$), though relatively lower compared to discipline and responsibility, is consistent with Self-Determination Theory's prediction that motivational quality influences engagement quality and therefore achievement. Students with higher intrinsic motivation toward physical activities demonstrate greater willingness to practice, persist through skill-acquisition challenges, and seek improvement feedback behaviors directly predictive of superior PE performance [33], [34].

The relatively smaller effective contribution of motivation (19.2%) compared to discipline and responsibility in this sample may reflect the fact that motivation was measured as a stable trait rather than a situational state, and that highly disciplined students may achieve well even when motivation is moderate, through habitual effort [35], [36]. Nevertheless, motivation functions as an essential energizing mechanism, and interventions aimed at enhancing autonomous motivation (e.g., autonomy-supportive teaching, mastery climate creation) have demonstrated effectiveness in improving both engagement and performance in PE contexts [37].

3.7 Discipline and Responsibility as Key Determinants

Discipline emerged as the variable with the strongest bivariate correlation with physical education achievement ($r = 0.833$), while responsibility contributed the largest effective contribution in the multiple regression model (27.6%). Together, these findings position self-regulatory behavioral dispositions as the most powerful proximal determinants of PE achievement in this sample. This pattern resonates with contemporary educational psychology's emphasis on self-regulation as a metacognitive superordinate factor that organizes and sustains goal-directed learning behavior across domains [38], [39].

The primacy of responsibility over other predictors in the regression model is theoretically meaningful. Unlike motivation, which may fluctuate situationally, responsibility represents a stable dispositional orientation toward one's learning obligations [40], [41]. A student who internalizes responsibility as a personal value will consistently complete assignments, attend classes prepared, and invest effort regardless of momentary motivational variations. This behavioral consistency translates directly into accumulated skill development and knowledge acquisition, ultimately manifesting in higher PE achievement scores [42], [43].

3.8 Simultaneous Contribution and Model Implications

The multiple regression model's exceptional explanatory power ($R^2 = 0.906$) suggests that the four constructs extracurricular activeness, learning motivation, discipline, and responsibility collectively constitute a comprehensive framework for understanding PE achievement variance. This level of explained variance is notably high for social science research, indicating that the chosen variables capture the dominant sources of achievement variation in this context [44], [45]. The remaining 9.4% variance may reflect factors such as teacher quality, sport facility adequacy, socioeconomic background, and peer influence, which were beyond the scope of this study.

The practical significance of these findings is substantial. School administrators can leverage this model to develop targeted interventions: strengthening extracurricular sport programs, implementing motivation-supportive physical education pedagogies, institutionalizing discipline-building routines, and cultivating a responsibility-oriented school culture [46], [47]. Notably, since responsibility emerged as the strongest predictor, character education initiatives emphasizing personal accountability, duty fulfillment, and consequence acceptance may yield the greatest returns in terms of PE achievement improvement [48], [49].

This research gained international perspective strengthening through cross-country collaboration between Indonesia, Turkey, and Mexico representing the physical education contexts of Southeast Asia, Eurasia, and Latin America. Although the empirical data were collected exclusively in Indonesia, the international collaboration among authors from Indonesia, Türkiye, and Mexico provided broader theoretical perspectives for interpreting the findings. The results are generally consistent with previous studies conducted in different educational contexts, suggesting that extracurricular participation, motivation, discipline, and responsibility are important factors associated with physical education achievement across diverse educational settings. However, future cross-

national studies are needed to verify the generalizability of these findings across different cultural and educational systems.In the Indonesian context, the results of the study indicate that extracurricular sports activities, learning motivation, discipline, and responsibility have a significant contribution to the physical education achievement of secondary school students, in line with the characteristics of the Indonesian education system which still places the character of education and collective activities as the foundation of learning. The Turkish perspective reinforces the importance of intrinsic motivation and active involvement of students in Physical Education learning as developed in the Self-Determination Theory approach widely applied in modern physical education in Turkey and Europe [50], [51]. Meanwhile, the Mexican perspective strengthens the dimensions of personal responsibility and social participation in physical activity, considering that Physical education in Latin America emphasizes the development of social character, community involvement, and the formation of healthy behaviors through school sports [52]. Thus, this cross-country collaboration shows that the relationship between extracurricular activities, motivation, discipline, responsibility, and physical education achievement is a universal phenomenon that is relevant in various educational systems and cultures.

Several limitations warrant acknowledgment. First, the cross-sectional correlational design precludes causal inference; the observed relationships indicate co-variation but not directionality. Second, the study was conducted at a single school in Grobogan Regency, limiting generalizability to other geographic and institutional contexts. Third, self-report questionnaire measures are susceptible to social desirability bias and recall limitations. Fourth, the sample comprised Science Track students, who represent a self-selected academically motivated group, potentially inflating observed relationships relative to less academically oriented student populations. Future research should employ longitudinal designs, multi-school samples, and objective behavioral measures to strengthen causal and generalizability claims.

4. CONCLUSION

This study demonstrates that sports extracurricular activeness, learning motivation, academic discipline, and personal responsibility each exhibit significant positive relationships with physical education achievement among eleventh-grade Science Track students at State Senior High School 1 Grobogan. Discipline and responsibility emerged as the strongest individual predictors, with correlation coefficients of $r = 0.833$ and $r = 0.796$ respectively. The combined four-factor model explained an exceptional 90.6% of physical education achievement variance ($R = 0.952$, $F(4,79) = 190.987$, $p < 0.001$), yielding the regression equation $Y = 36.369 + 0.176X_1 + 0.236X_2 + 0.235X_3 + 0.341X_4$, in which responsibility contributed the highest effective contribution (27.6%), followed by discipline (23.5%), extracurricular activeness (20.4%), and learning motivation (19.2%).

These findings carry both theoretical and practical significance. Theoretically, this study advances the understanding of physical education achievement by demonstrating that behavioral and self-regulatory factors, particularly responsibility and discipline, exert stronger predictive influence than motivational and extracurricular factors when examined simultaneously within a single regression model. This contributes to the growing body of literature on self-regulation in physical education contexts and provides empirical support for integrating affective and behavioral constructs into physical education achievement frameworks. Practically, physical education teachers are encouraged to adopt autonomy-supportive and mastery-oriented instructional approaches to enhance students' intrinsic motivation, while school administrators should institutionalize discipline-building routines within both formal physical education classes and extracurricular settings. Character education curricula should prioritize the development of personal responsibility as the highest-impact behavioral predictor of physical education achievement, and schools should sustain diverse sport extracurricular programs as a pedagogically sound extension of formal physical education instruction. Future research should employ longitudinal, multi-site designs with mixed-method approaches to further clarify the mechanisms through which these behavioral and affective factors shape physical education outcomes across diverse educational contexts.

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AUTHOR CONTRIBUTIONS

Conceptualization, I.D.F. and S.; Methodology, I.D.F., S., and B.Y.; Software, I.D.F.; Validation, S., B.Y., and C.M.S.A.; Formal Analysis, I.D.F. and B.Y.; Investigation, I.D.F. and S.; Resources, S. and B.Y.; Data Curation, I.D.F.; Writing – Original Draft Preparation, I.D.F. and S.; Writing – Review & Editing, B.Y. and C.M.S.A.; Visualization, I.D.F.; Supervision, B.Y. and C.M.S.A.; Project Administration, I.D.F. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

Not applicable.

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