



## The Role of Physical Education in Enhancing Sustainable Development Goals 2, 3, 4, and 5: Insights from Student Perceptions

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### Abstract

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This study investigates the role of Physical Education (PE) in advancing the Sustainable Development Goals (SDGs), with a particular focus on those related to health, education, and gender equality. Employing a mixed-methods approach, the research commenced with a Focus Group Discussion (FGD) involving three expert Physical Education teachers to identify relevant sub-SDGs supported by PE. Insights from the FGD informed the development of a questionnaire designed to assess students' perceptions of PE's contribution to these goals. The survey was distributed to 280 male and 452 female high school students aged 16–18. Findings indicate that both male and female students perceive PE positively in relation to SDG achievement, with average scores of 3.86 for males and 3.84 for females. Statistical analysis using the Mann-Whitney U test revealed no significant gender differences ( $U = 64920$ ,  $p = 0.555$ ), indicating that both genders hold similar views regarding the importance of PE in supporting SDGs. The study concludes that PE is instrumental in promoting health, education, and gender equality, thereby contributing to the realization of the SDGs, with only minimal differences in perceptions between male and female students.

**Keywords:** Physical Education, Sustainable Development Goals, Gender Equality, Health Education, Student Perceptions, SDG Achievement

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### PENDAHULUAN

The Sustainable Development Goals (SDGs) constitute a global framework established by United Nations (UN) member states in 2015 to promote sustainable social, economic, and environmental development by 2030. Encompassing 17 interrelated objectives, the SDGs address critical global challenges such as poverty, hunger, inequality, climate change, environmental degradation, and social injustice (Chaleta et al., 2021; Ferrer-Estévez & Chalmeta, 2021). Each goal is associated with specific targets and measurable indicators to track progress (Rojas et al., 2021). The SDGs require the participation of governments, the private sector, civil society organizations, and individuals to achieve these objectives collaboratively (Ahali, 2022). Their significance lies in the collective effort to enhance global quality of life, ensure environmental sustainability, and promote social justice.

Physical Education (PE) plays a pivotal role in advancing the Sustainable Development Goals (SDGs), particularly those related to health, quality education, and gender equality (Campillo-Sánchez et al., 2025; Rahmawati et al., 2024). Through structured instruction in physical activity, nutrition, and stress management, PE enhances both the physical and mental health of students (Han et al., 2025). SDG 3 (Good Health and Well-Being) underscores the importance of maintaining community health. Participation in PE activities not only improves students' physical fitness but also fosters an understanding of healthy nutritional habits and the prevention of non-communicable

diseases (Apriyano et al., 2022; Siddik et al., 2024). Additionally, PE advances SDG 5 (Gender Equality) by providing equal opportunities for boys and girls to participate in physical activity and pursue sports leadership, thereby promoting gender equality within educational and social contexts (Kaur, 2025).

Physical Education (PE) also contributes to SDG 4 (Quality Education) by providing accessible and equitable educational opportunities for all students, including those with special needs (Nariz II, 2025). Activities such as games, physical exercise, and social engagement in PE foster values including cooperation, discipline, and leadership, which support holistic and integrated learning (Fizi et al., 2023; Gulo et al., 2024). Instruction on healthy lifestyles within PE is essential for supporting SDG 2 (Food Security and Good Nutrition), as the curriculum educates students about the importance of nutritious food and physical activity for optimal growth (González et al., 2025; S. M. Lee et al., 2023; Yunus et al., 2025). Thus, PE not only promotes physical health but also equips individuals with strategies for achieving sustainable well-being, in alignment with SDG principles. PE's support for the SDGs aligns with its fundamental characteristics. Specifically, PE can contribute to sub-targets 2.1 and 2.2 of SDG 2; 3.3, 3.4, and 3.5 of SDG 3; 4.2, 4.5, 4.6, and 4.7 of SDG 4; and 5.1 and 5.5 of SDG 5.

Table 1. Explanation of the Supporting Capacity of Physical Education and Health for Sub SDGs

No.	Sub SDG	Overview of Physical Education's Impact
1	2.1 By 2030, eliminate hunger and guarantee access for all, especially the poor and those in vulnerable conditions, including infants, to safe, nutritious, and sufficient food all year round.	Physical Education (PE) increases understanding of healthy eating and nutrition through integrating nutrition education with physical activities that encourage overall health.
2	2.2 By 2030, eliminate all forms of malnutrition, including by 2025 achieve internationally agreed targets for short and thin children under 5 years of age, and meet the nutritional needs of adolescent girls, pregnant and lactating women, and the elderly.	PE contributes to reducing malnutrition by emphasizing the importance of healthy food for the growth of adolescents and other vulnerable populations, including pregnant women and older adults.
3	3.3 By 2030, end the neglected epidemics of AIDS, tuberculosis, malaria, and tropical diseases, and combat hepatitis, waterborne	PE aids in the prevention of infectious diseases by providing hygiene education and fostering regular physical activity to

No.	Sub SDG	Overview of Physical Education's Impact
4	diseases, and other infectious diseases.	strengthen the immune system.
	3.4 By 2030, reduce premature deaths from non-communicable diseases by one-third, through prevention and treatment, and improve mental health and well-being.	PE supports the prevention of non-communicable diseases by supporting regular exercise and teaching stress management techniques to advance mental health.
5	3.5 Strengthen the prevention and treatment of substance abuse, including narcotics abuse and harmful alcohol use.	PE addresses drug and alcohol abuse by delivering health education and offering healthy alternatives by structured physical activities.
6	4.2 By 2030, guarantee that all girls and boys have access to quality early childhood development and care, nursing, primary pre-school education, so that they are ready to pursue primary education.	PE fosters child development by guaranteeing fair access to physical activities that promote both physical and mental development.
7	4.5 By 2030, eliminate gender disparities in education, and guarantee equal access to all levels of vocational education and training, for vulnerable communities, including persons with disabilities, indigenous communities, and children in vulnerable conditions.	PE reduces gender disparities by offering equal opportunities for participation and leadership in physical activities and sports for both women and men.

No.	Sub SDG	Overview of Physical Education's Impact
8	4.6 By 2030, guarantee that all adolescents and a certain proportion of adult groups, both male and female, have literacy and numeracy skills.	PE enhances numerical literacy by engaging students in calculating physical activity outcomes, such as pulse rate, speed, and interpreting fitness graphs.
9	4.7 By 2030, guarantee all learners acquire the knowledge and skills necessary to promote sustainable development, including, inter alia, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and cultural contribution to sustainable development.	PE promotes sustainable lifestyles and gender equality through incorporating cooperative physical activities that foster appreciation for cultural diversity.
10	5.1 End all forms of discrimination against women everywhere.	PE advances gender equality by making sure that both women and men have equal opportunities to participate in and lead sports.
11	5.5 Guarantee full and effective participation, and equal opportunities for women to lead at all levels of decision-making in political, economic, and societal life.	PE encourages women to take the lead in sports activities, providing them with equal opportunities in decision-making in the field of sport.

Recognizing the capacity of physical education, sport, and health to support the SDGs is a crucial first step in optimizing their role in achieving these objectives (Fröberg & Lundvall, 2021,

2022; Merma-Molina et al., 2023). Integrating physical activities that promote health, equity, and quality education positions physical education as an effective vehicle for fostering a healthier, better-educated, and more empowered generation (Khory et al., 2023; Susila et al., 2025). Given the importance of the SDGs in global development, understanding the contributions of physical education underscores its essential role in advancing social welfare, gender equity, and sustainable development (Aniciete et al., 2025; Boned-Gómez et al., 2024). This perspective also informs the evaluation of educational policies and provides valuable insights for developing physical education curricula and pedagogical methods that enhance inclusion and alignment with SDG objectives. Ultimately, acknowledging the supporting role of physical education in the SDGs establishes a foundation for designing more relevant programs that effectively and equitably promote sustainable development.

## METHOD

This study examines the role of Physical Education, Sport, and Health (PE) in supporting the achievement of the Sustainable Development Goals (SDGs), with a specific focus on health, education, and gender equality. The initial phase involved reviewing SDGs relevant to PE through a Focus Group Discussion (FGD) with three experts in the field. The FGD, comprising experienced high school PE teachers, explored their perspectives on which sub-SDGs PE can support and the specific contributions PE can make toward achieving these goals.

Following the FGD and subsequent analysis, a questionnaire was developed to measure students' knowledge and involvement in PE activities that support the SDGs. The questionnaire employed a Likert scale ranging from 1 to 5, with intervals determined by a specified formula. Each item assessed students' perspectives on health, nutrition, physical activity, and gender equality in sport. The questionnaire was reviewed by the PE experts who participated in the FGD. Data were analyzed for each sub-SDG using both quantitative and descriptive methods. Statistical analysis was conducted using either the independent t-test or the Mann-Whitney test, depending on the results of the prerequisite test.

Table 2. Scoring Range

Score	Category
1,00 - 1,80	Strongly Disagree
1,81 - 2,60	Disagree
2,61 - 3,40	Hesitation
3,41 - 4,20	Agree
4,21 - 5,00	Strongly Agree

The study sample consisted of 280 male and 452 female high school students aged 16 to 18. This age group, representing the final stage of secondary education prior to higher education, is critical for examining how PE influences students' understanding of health, gender equality, and social well-being during this transitional period.

## RESULT AND DISCUSSION

### 1. SDG 2: End Hunger, Achieve Food Security and Good Nutrition, and Improve Sustainable Agriculture

Analysis of students' perceptions regarding physical education (PE) support for SDG 2 revealed that male students reported slightly higher scores than female students. For sub-SDG 2.1, which concerns access to safe, nutritious, and adequate food, the average score for male students was 4.04, while female students scored 4.02. Both scores are within the "Agree" category (range 3.41–4.20), indicating consensus that PE supports understanding of healthy nutrition and nutritious foods for physical health. Statistical analysis using the Mann-Whitney U test (test statistic: 66934.5, p-value: 0.1854) demonstrated no significant difference in male and female students' perceptions of PE's contribution to sub-SDG 2.1.

The minimal difference in scores suggests that both genders hold similar views regarding the importance of a nutritious diet for physical health. Numerous factors may explain this similarity:

- a. PE teaches the importance of healthy nutrition and nutritious food as part of physical health learning, without differentiation between men and women. Both genders receive equal

knowledge regarding the relationship between good nutrition and body health (K. L. Lee & Sung, 2025; Nurhabibah et al., 2025; Tüfekçi et al., 2021).

- b. Awareness of healthy nutrition is increasing across genders. Both male and female students are increasingly recognizing the importance of nutritious foods for growth, energy, and overall health (Alzaben et al., 2025; Douglas et al., 2022).
- c. Information about healthy nutrition is now widely accessible to all students through social media, wellness campaigns, and educational materials, helping to a more equitable understanding between genders (Andonova et al., 2022; Bacheva et al., 2024).
- d. The perception of healthy nutrition is no longer mainly associated with one gender. Both male and female students now demonstrate similar awareness regarding the value of proper nutrition for physical health (Hanslian et al., 2024; Tüfekçi et al., 2021).

To summarize, the minimal difference in scores does not show a significant gap in male and female students' understanding of healthy nutrition. Both groups agree that PE supports their understanding of healthy, nutritious food as essential to physical health.

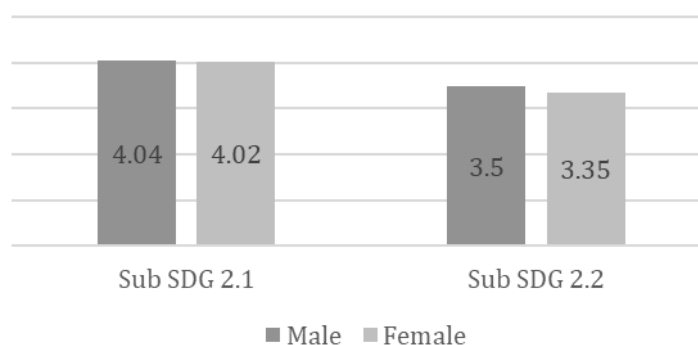
In sub-SDG 2.2, which emphasizes nutrition for vulnerable groups, such as adolescent girls, pregnant women, and the elderly, male students scored 3.50, while female students scored 3.35. The score was in the "Agree" category (range 3.41 - 4.20), indicating that although there were differences in scores, both men and women agreed that PE contributes to their understanding of nutrition for vulnerable groups. However, because the score is at the bottom of the "Agree" range, it shows that while there is agreement on PE support, there is room to strengthen nutrition-related material for vulnerable groups in the PE curriculum. The Mann-Whitney U test also showed no significant difference in perceptions between male and female students. With test statistics of 63985.5 and a p-value of 0.7985, where p-value >0.05. This indicates that there is no significant difference in perceptions of PE's carrying capacity relative to sub-SDG 2.2.

The results showed that in general, both genders agreed that PE contributed to their understanding of the importance of nutrition for vulnerable groups. Both scores fall within the "Agree" range, indicating that, despite agreement on PE support, there is still room to strengthen nutrition-related materials for vulnerable groups in the PE curriculum. Factors that affect student perception:

- a. While PE covers the fundamentals of healthy nutrition, it lacks specific emphasis on nutrition for vulnerable groups such as pregnant women and seniors. Curriculum materials can be further clarified and contextualized to students' daily lives to enhance appreciation of nutrition's role for these populations (Alghamdi et al., 2023; Permatasari et al., 2021; Puri et al., 2023).
- b. Among male students, nutrition for vulnerable groups may be seen as less relevant to their personal needs, which are often centered on physical activity and self-improvement. Including more educational materials focused on vulnerable groups, including pregnant women and seniors, may help address this gap (D'Antonio et al., 2024; Deng et al., 2024).
- c. Nutrition materials for vulnerable groups can also be strengthened by integrating them into PE activities, such as projects or group discussions that use real-life examples of the role of nutrition for pregnant women and seniors in daily life (Perry et al., 2025). This can clarify the relationship between a healthy diet and the health of vulnerable groups, thereby helping students better understand this topic.

Although male and female students demonstrated similar agreement regarding PE's support to understand nutrition for vulnerable groups, the slight difference in scores indicates a need to further improve curriculum content specific to pregnant women and seniors. Greater emphasis on this topic will help students recognize and apply the importance of nutrition for at-risk groups.

Diagram 1. Comparison of SDG 2 Scores



## 2. SDG 3: Good Health and Well-Being

SDG 3 focuses on improving physical and mental well-being and preventing infectious and non-communicable diseases. Based on students' perceptions of PE support for SDG 3, male students tended to score higher than female students, indicating that men were more likely to agree that PE supported achieving SDG 3 than women. In sub-SDG 3.3, which focuses on tackling infectious diseases, the average score for male and female students is 3.97. This score falls into the "Agree" category (range 3.41 - 4.20), which indicates that both genders agree that PE plays a role in preventing infectious diseases through physical activity and hygiene education. The Mann-Whitney U test also showed no significant difference in perceptions between male and female students. With test statistics of 60181.0 and a p-value of 0.2614, where p-value >0.05. This indicates that there is no significant difference in perceptions of PE's carrying capacity relative to sub-SDG 3.3.

Both genders agree that PE plays a role in managing infectious diseases through physical activity and hygiene education. Factors that affect student perception:

- a. PE teaches body health, personal hygiene, and prevention of infectious diseases through physical activity (Chastin et al., 2021; Filgueira et al., 2021). Both genders have an equal understanding of how physical activity boosts immunity and helps prevent the transmission of infectious diseases. Therefore, both men and women agree that PE makes a substantial contribution to the management of infectious diseases.
- b. Hygiene is one of the key materials in PE education taught to all students, fostering gender awareness of the importance of good hygienic practices to prevent the transmission of infectious diseases (Almoslem et al., 2021). Both men and women are taught the importance of washing hands, maintaining environmental cleanliness, and practicing personal hygiene to prevent infectious diseases (Patel et al., 2025).

The results showed that both genders agreed that PE has a role in the management of infectious diseases through hygiene and health education. Similar scores between men and women (3.97) suggest that PE support in this regard is well received by both genders, with no significant differences in their perceptions of PE's role in preventing infectious diseases. This reflects an equal awareness of the importance of healthy lifestyles, hygiene, and physical activity in preventing the transmission of infectious diseases among students.

Within sub-SDG 3.4, which addresses the reduction of deaths from non-communicable diseases and the improvement of mental health, male students reported a mean score of 4.11, while female students reported a mean score of 3.97. Both groups acknowledged that physical education (PE) supports their physical and mental health; however, male students showed slightly higher agreement, indicating greater recognition of PE's role in these areas. The Mann-Whitney U test showed a statistically significant difference in perceptions between male and female students, with a test statistic of 72670.5 and a p-value of 0.00067 ( $p < 0.05$ ). These observations point to a significant difference in perceptions of PE's contribution to sub-SDG 3.4.

Although the scores differ significantly, both fall within the "Agree" category (range 3.41–4.20), indicating consensus among genders that physical education (PE) contributes to enhanced physical and mental health. However, male students showed slightly higher agreement, suggesting greater recognition of PE's role in supporting both physical and psychological well-being. The following factors influence student perceptions:

- a. In addition to encouraging physical health, PE educates students about the value of mental well-being through activities such as stress management and emotional fitness (Chawre, 2025a). Male students tend to participate more in the physical components of PE, whereas female students may concentrate more on affective and psychological learning aspects (Makrooni et al., 2025a). While both genders acknowledge PE's function in promoting mental health, the observed score differences indicate that male students may be better attuned to the immediate physical benefits, which, in turn, improve their psychological well-being.
- b. In certain cultural and social contexts, men are more likely to accentuate the importance of physical health and strength through exercise, whereas women may participate more vigorously in discussions regarding mental and emotional health (Abdoli et al., 2024). Nevertheless, as mental health awareness increases within the PE curriculum, both genders are becoming more receptive to the value of mental health.
- c. Physical activity in PE not only focuses on physical health, but also helps to manage stress and promote psychological well-being (Stefanica et al., 2025; Zafar et al., 2025). Male students feel more engaged in structured exercise, which directly reduces stress and improves psychological health. Results showed that PE improves the physical and mental health of both genders.

Although men slightly agreed that PE supports their physical and mental health, both genders agreed that PE plays a role in reducing non-communicable diseases and improving mental health, with men being slightly more aware of PE's role regarding physical health, while women may be more focused on mental health. However, the small difference in scores suggests that PE's support in supporting physical and mental health is well received by both genders.

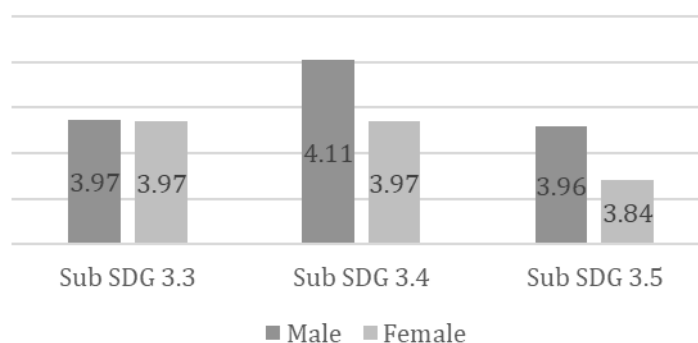
Within sub-SDG 3.5, which addresses drug and alcohol abuse, male students reported a mean score of 3.96, while female students reported a mean score of 3.84. These results suggest that male students are marginally more likely to agree that physical education (PE) contributes to the prevention of drug and alcohol abuse; however, the difference is minimal. The Mann-Whitney U test yielded a test statistic of 59948.0 and a p-value of 0.2276, which exceeds the 0.05 threshold. Therefore, there is no statistically significant difference in perceptions of PE's role regarding sub-SDG 3.5 between male and female students.

Although there is a difference in scores between male and female students, it is neither substantial nor statistically significant. Both groups agree that PE makes a positive contribution to dealing with this issue. Numerous factors influence student perceptions:

- a. The PE curriculum frequently integrates topics related to drug and alcohol abuse with education on healthy lifestyles and stress management through physical activity (Yang et al., 2024). This merging contributes to consensus between male and female students regarding the role of PE in substance abuse prevention.
- b. Physical activities conducted in PE help improve mental health and assist students in managing stress (Fu et al., 2025; Roccliffe et al., 2024). Taking part in these activities encourages students to focus on their physical and mental well-being, which may increase their awareness of the importance of avoiding substance abuse (Donnelly et al., 2024; Halladay et al., 2024).
- c. Regarding the dangers of drugs and alcohol, the PE often provides an understanding of the negative impact of substance abuse on physical and mental health (Mason & Heyser, 2021; Nyulas et al., 2024). This increases students' awareness of the importance of avoiding drug and alcohol abuse.

The results of this study show that PE receives strong support from both genders in supporting the prevention of drug and alcohol abuse. Men were slightly more likely to agree with the statement that PE plays a role in preventing drug and alcohol abuse, which can be explained by their higher levels of involvement in physical activity and their awareness of stress management through exercise. Although there was a difference in scores between men and women, this difference was not very significant, and both overall agreed that PE provides important support in the prevention of drug and alcohol abuse.

Diagram 2. Comparison of SDG 3 Scores



### 3. SDG 4: Quality Education

SDG 4 aims to guarantee equitable and high-quality education for all. An analysis of students' perceptions of the role of physical education (PE) in achieving SDG 4 found that male students reported slightly higher agreement scores than female students, denoting a greater likelihood among males of perceiving PE as adding to SDG 4. For sub-SDG 4.2, which focuses on early childhood development and primary pre-school education, male students averaged 4.06, while female students averaged 3.88. Both scores are within the "Agree" category (range 3.41–4.20), but male students demonstrated greater agreement regarding the role of PE in supporting body and brain development through physical activities. The Mann-Whitney U test indicated a statistically significant difference in perceptions between male and female students, with a test statistic of 70133.5 and a p-value of 0.0127 ( $p < 0.05$ ). This result shows a significant difference in perceptions of PE's contribution to sub-SDG 4.2.

Regarding sub-SDG 4.2, which emphasizes early childhood development and primary pre-school education, male students averaged 4.06, while female students averaged 3.88. Although both scores fall within the "Agree" category (range 3.41–4.20), the difference is statistically significant. Numerous factors could contribute to these differing perceptions:

- a. Physical education (PE) stresses the importance of physical activity for body and brain development (Chawre, 2025b). While male students scored slightly higher, both genders demonstrated an understanding that physical activity in PE supports physical and cognitive development. Males are generally more actively involved in physical activity than females (Ahmed & Al Salim, 2024). Structured physical activity in PE can improve motor coordination, body strength, and mental abilities such as thinking and focus, which play a key role in brain development (González-del-Castillo & Barbero-Alcocer, 2025).
- b. Physical activity in PE benefits not only physical health, but also contributes to cognitive development. Enhancing motor skills through play and movement can stimulate brain development and support skills such as thinking, focus, and creativity (Bharti, 2025; Latino et al., 2024).
- c. PE also promotes the adoption of healthy habits from an early age, including a balanced diet, regular exercise, and stress management (Trigueros et al., 2021). Both genders receive instruction on the benefits of physical activity for physical growth and mental development. The slightly higher agreement among male students regarding PE's support for body and brain development may be attributed to their greater involvement in physical activity in PE lessons (Ahmed & Al Salim, 2024).

The findings indicate that PE supports the development of students' bodies and brains through physical activities integrated into the curriculum. Although there are minor differences between male and female students, both groups agree that PE contributes to their physical and cognitive development. The slightly higher agreement among males is likely due to their greater participation in physical activity during PE. Overall, both genders hold similar views regarding the role of PE in supporting body and brain development.

Sub-SDG 4.5 seeks to eliminate gender disparities in education. Male students reported an average score of 3.86, while female students reported an average score of 3.89. Although the average score for female students was slightly higher, both means fall within the "Agree" category, indicating that both groups perceive physical education (PE) as providing equal opportunities for participation

in physical activity and supporting gender equality in sports education. The Mann-Whitney U test produced a test statistic of 61892.5 and a p-value of 0.6156 ( $p > 0.05$ ), demonstrating no significant difference in perceptions between male and female students regarding PE's correspondence with sub-SDG 4.5.

The objective of Sub-SDG 4.5, which is to eliminate gender disparities in education, is reflected in the average scores of male (3.86) and female (3.89) students. Both scores fall within the "Agree" category (range 3.41–4.20), showing a consensus that PE offers equal opportunities for participation in physical activity and supports gender equality in sports education. Numerous factors influence these students' perceptions:

- a. PE is designed to provide equal opportunities for all students, regardless of gender, to participate in physical activity (Guerrero & Puerta, 2023). The curriculum highlights cooperation, respect for opponents, and the development of physical skills for all students (Zhou et al., 2023). These components help form the perception that PE fosters gender equality in school-based physical activity.
- b. Both male and female students are instructed to value equality in sport, making sure that all students have equal opportunities to develop their physical abilities (Martínez et al., 2023). Inclusive PE education enables participation in a diverse range of physical activities for both genders, as demonstrated by the nearly equal scores between male and female students.
- c. A more diverse PE curriculum that provides opportunities for both women and men to participate in various sports activities fosters shared awareness of the importance of gender equality in physical education (Makrooni et al., 2025b).

The results show that PE contributes to eliminating gender disparities in sports education. While female students are marginally more likely to agree that PE supports gender equality in physical education, both genders concur that PE provides equal opportunities for all students to participate in physical activity. The nearly equal scores suggest that both groups hold similar views regarding PE's support for gender equality in sports education.

Sub-SDG 4.6, which addresses literacy and numeracy skills, revealed that male students scored 3.69 and female students scored 3.59. Both scores fall within the "Agree" category, indicating that both genders perceive physical education (PE) as supporting the improvement of students' numeracy and literacy skills through activities such as counting pulses or measuring distance. However, male students showed higher agreement. The Mann-Whitney U test produced a test statistic of 72651.5 and a p-value of 0.0007 ( $p < 0.05$ ), indicating a statistically significant difference in male and female students' perceptions of the contribution of PE to sub-SDG 4.6.

Sub-SDG 4.6 shows significant differences, but both genders agree that PE plays a role in improving students' numerical abilities and literacy through measurements and analyses carried out in physical activity, such as counting pulses or measuring distance. Factors that affect student perception:

- a. Male and female students often have different experiences in PE activities. Male students may participate more frequently in activities involving measurement or numerical calculations, such as running, counting pulses, or measuring distance, which could reinforce their perception that PE enhances numeracy and literacy abilities (Atho'illah et al., 2025; Frühauf et al., 2022).
- b. It is possible that male and female students have different perceptions of the value and benefits of PE. In some cultures or social contexts, male students are seen as more likely to be interested in challenging sports or physical activities, which leads to the view that PE develops their cognitive abilities, including numeracy and literacy (Qin et al., 2025; Russo et al., 2025).
- c. The teaching techniques used in PE in schools can influence students' perceptions of PE's role in literacy and numeracy. If teaching is more based on physical aspects with no obvious link to numeracy or numerical calculations, then women, who are more interested in cognitive or non-physical aspects, may see PE as less relevant to improving those skills (Kolovelonis & Goudas, 2023). In contrast, men who are more active in physical activities may experience greater benefits (Grynyova et al., 2025).
- d. Male students may be more likely to associate physical activities, such as distance or speed calculations, with improvements in numerical ability due to more frequent exposure to these activities (Pascual et al., 2025). In contrast, female students may focus on aspects of PE that are less directly related to numeracy or literacy skills (Barnett et al., 2024).

To summarize, differences in perceptions between male and female students regarding PE's function in improving numeracy and literacy skills are shaped by elements such as varied experiences with physical activity, differing perceptions of PE's value, instructional methods, and the emphasis on

calculation-related activities. These factors reflect underlying social, cultural, and psychological distinctions that determine how each gender views the relationship between PE and academic skills. Further research should investigate these factors in greater depth and develop inclusive instructional approaches to promote the active participation of female students in employing PE to improve numeracy and literacy.

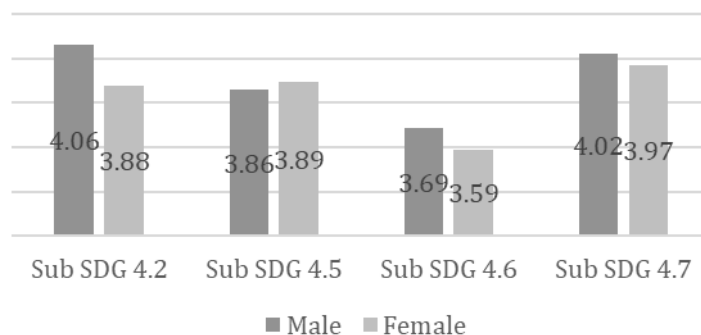
For sub-SDG 4.7, which addresses knowledge and skills for sustainable development, male students had an average score of 4.02, while female students scored 3.97. Both scores fall within the "Agree" category, indicating that both genders perceive physical education (PE) as supportive of their understanding of sustainable lifestyles, gender equality, and global citizenship. The Mann-Whitney U test produced a test statistic of 61219.5 and a p-value of 0.4552, which is greater than 0.05. This result shows that there is no significant difference between male and female students' perceptions regarding the contribution of PE to sub-SDG 4.7.

Sub-SDG 4.7 shows that both genders agree that PE supports their understanding of sustainable lifestyles, gender equality, and global citizenship. Factors that affect student perception:

- PE educates all students, regardless of gender, about the importance of a sustainable lifestyle that incorporates environmentally friendly physical activity and productive resource use (Schnitzler et al., 2025). Both male and female students receive equal instruction on sustainable lifestyles, emphasizing physical activities that promote personal health while also supporting ecological and community sustainability.
- PE contributes to gender equality by providing all students with equal opportunities to participate in physical activities (Işıkgöz et al., 2025a). This approach fosters an understanding of gender equality, as both male and female students recognize that PE helps them comprehend their roles in promoting equality within physical education and sport.
- Through group activities and in-play cooperation in PE, students are taught to work together with friends from different backgrounds, which introduces them to the values of global citizenship (Hovdal et al., 2021). This education helps students understand that international cooperation and tolerance are essential to achieving sustainable development goals.

The results showed that PE received positive support from both genders in supporting their understanding of sustainable lifestyles, gender equality, and global citizenship. Male students are slightly more likely to agree with this statement, suggesting they are more engaged in physical activity and are more aware of sustainable lifestyles and worldwide cooperation. However, this difference in scores was not significant, and overall, both genders agreed that PE played a role in educating them about values related to sustainable development, gender equality, and global citizenship.

Diagram 3. Comparison of SDG 4 Scores



#### 4. SDG 5: Gender Equality and Women's Empowerment

SDG 5 seeks to achieve gender equality across multiple domains, including sports education. Analysis of students' perceptions regarding physical education's (PE) support for SDG 5 revealed that male students scored marginally higher than female students. This data suggests that male students are more likely to agree that PE supports gender equality and the empowerment of women in sports education.

For sub-SDG 5.1, which addresses the elimination of discrimination against women, the average score for male students was 3.67, while female students scored 3.65. Both scores fall within the 'Agree' category (range 3.41–4.20), indicating consensus that PE supports gender equality in physical

activity and sport. Although male students are slightly more likely to agree that PE addresses gender discrimination in sports education, the Mann-Whitney U test ( $U = 65291.5$ ,  $p = 0.4661$ ) showed no significant difference in perceptions between male and female students ( $p > 0.05$ ). This result suggests that perceptions of PE's contribution to sub-SDG 5.1 are statistically similar across genders.

The findings for sub-SDG 5.1 indicate that both male and female students agree that PE supports gender equality in physical activity and sport, with male students showing slightly higher agreement about PE's role in tackling gender discrimination. Numerous factors influence student perceptions:

- a. PE offers equal opportunities for all students, regardless of gender, to participate in physical activity and sport. The curriculum is organized to guarantee impartial opportunities for both male and female students to compete and develop physical skills (Lalog, 2025). This approach fosters similar levels of agreement among male and female students regarding PE's contribution to gender equality in sports education.
- b. In PE, students are taught to respect their opponents and work together in teams, regardless of gender (Santos Pastor et al., 2021). PE teaches that sport knows no gender and that each pupil has the same right to participate in physical activity. This contributes to both genders' awareness of gender equality in sports education.
- c. PE contributes to eliminating gender stereotypes commonly associated with physical activity. While certain sports may be regarded as more appropriate for one gender because of prevailing social norms, PE makes certain that all students have equal opportunities to participate in all types of sport, thereby directly supporting gender equality (Avraam & Anagnostou, 2022; Işıkğöz et al., 2025b). Despite minor differences in perception scores, both male and female students recognize that PE offers equal opportunities in physical activity.

These results show that PE has the support of both genders in supporting gender equality in physical activity and sport. Although men are slightly more likely to agree that PE helps address gender discrimination, both genders agree that PE contributes to gender equality in sports education. This small difference in scores suggests that equality in school sports participation is already sufficiently guaranteed, although there is room to continue strengthening education about gender equality and to remove gender stereotypes in physical activity.

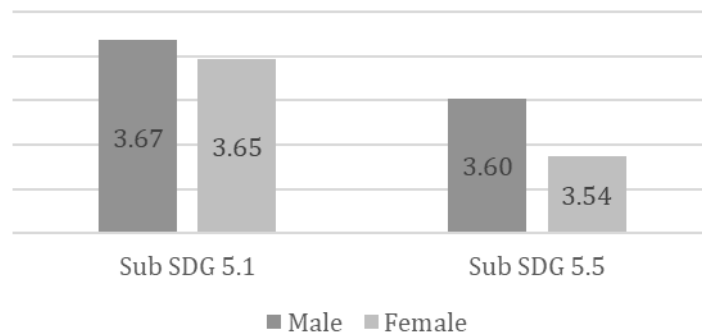
Within sub-SDG 5.5, which addresses women's participation in leadership, male students reported a mean score of 3.60, while female students reported a mean score of 3.54. These results suggest that male students are marginally more likely to agree that they have greater opportunities to assume leadership roles in physical education (PE) activities. Both scores fall within the "Agree" category, indicating that both genders acknowledge the leadership opportunities provided by PE, though men appear more active in such roles. The Mann-Whitney U test showed a significant difference in perceptions between male and female students, with a test statistic of 56332.0 and a p-value of 0.0119 ( $p < 0.05$ ). This finding demonstrates a statistically significant difference in perceptions of PE's capacity to support sub-SDG 5.5.

Sub-SDG 5.5, which concerns women's participation in leadership, indicates that both male and female students perceive physical education (PE) as providing opportunities for leadership in physical activity. Although minor differences are present, the data show that male students are somewhat more likely to agree that they have greater opportunities to lead in PE activities. Nonetheless, both groups acknowledge PE's role in fostering leadership opportunities. Multiple factors contribute to these student perceptions:

- a. Physical education offers equal opportunities for male and female students to assume leadership roles in physical activity (Guerrero & Puerta, 2023). However, men are somewhat more likely to perceive that they have greater chances of leading in sporting activities. This perception is shaped by prevailing social norms, which often lead to a higher proportion of men occupying leadership positions in competitive and physical activities (Bryan et al., 2021).
- b. Physical education aims to provide equal opportunities for women and men in sports leadership. Inclusive PE programs, which emphasize gender equality in leadership, have significantly increased awareness that women can also lead in physical activity (Işıkğöz et al., 2025b). This is reflected in the data, which show that while men agree to a slightly greater extent, women also recognize that PE offers leadership opportunities.

The results show that both male and female students agree that physical education provides equal opportunities for leadership in physical activity. Although men are marginally more likely to perceive greater opportunities to lead, both genders recognize the role of PE in facilitating leadership. The small difference in agreement suggests that gender equality in sports education leadership is generally sufficient, but there remains potential to further enhance women's participation in sports leadership.

Diagram 4. Comparison of SDG 5 Scores



## 5. Overall results

The results of this study show that both male and female participants hold a positive perception of the role of Physical Education (PE) in supporting the achievement of the Sustainable Development Goals (SDGs). The average score for men was 3.86, while that for women was 3.84. This evidence indicates that both groups recognize the significant contribution of Physical Education to various SDGs, with only a minimal difference in agreement levels. A Mann-Whitney U test was conducted to determine whether this difference was statistically significant. The analysis showed no significant difference between male and female scores (U statistic = 64920.0, p-value = 0.555), indicating that both genders share similar perspectives regarding the importance of Physical Education in furthering the SDGs.

This study demonstrates that Physical Education (PE) plays a significant and multidimensional role in supporting the achievement of SDGs 2, 3, 4, and 5. The overall findings reveal that both male and female students hold positive perceptions of PE's contribution to sustainable development, with no statistically significant difference in overall perception ( $p = 0.555$ ). This indicates that PE is recognized as an inclusive educational platform capable of advancing health literacy, gender equality, nutrition awareness, and sustainable citizenship values.

These findings reinforce the conceptual arguments proposed by Fröberg & Lundvall (2021, 2022), who emphasize that PE possesses distinct pedagogical potential within the Agenda 2030 framework. Similarly, Campillo-Sánchez et al. (2025) and Aniciete et al. (2025) highlight sport and PE as strategic vehicles for advancing SDGs related to public health and social equity. The present study extends these theoretical discussions by providing empirical evidence from student perceptions at the secondary school level. In relation to SDG 3 (Health and Well-being), the findings align with Chastin et al. (2021) and Rocliffe et al. (2024), who reported that structured physical activity improves immune response and adolescent mental health. The strong agreement among students regarding PE's contribution to disease prevention and mental well-being suggests that health-oriented PE curricula are effectively internalized. The small but significant gender differences in sub-SDG 3.4 (mental health and NCD prevention) may be influenced by varying levels of engagement in physical activity, as also suggested by Ahmed & Al Salim (2024).

Regarding SDG 4 (Quality Education), this study supports Kolovelonis & Goudas (2023), who found that cognitively challenging PE activities enhance executive function and academic skills. The significant gender difference observed in sub-SDG 4.6 (literacy and numeracy) may stem from differences in activity participation patterns, echoing findings by Frühauf et al. (2022) concerning gendered experiences in PE settings. For SDG 5 (Gender Equality), the findings are consistent with Guerrero & Puerta (2023) and Işıkgöz et al. (2025), who emphasize inclusive PE as a tool for reducing gender disparities. Although leadership perception differences (sub-SDG 5.5) were statistically significant, both genders remained within the "Agree" category, suggesting that gender equality initiatives in PE are progressing positively.

Overall, similarities with previous studies likely arise from shared curricular frameworks that integrate health education, inclusive participation, and cooperative learning models. Differences may be attributed to contextual factors such as cultural norms, gender role expectations, instructional strategies, and measurement approaches (self-perception-based survey versus experimental or intervention-based research).

The novelty of this research lies in its integrated empirical mapping of specific SDG sub-targets (2.1, 2.2, 3.3, 3.4, 3.5, 4.2, 4.5, 4.6, 4.7, 5.1, and 5.5) within the context of secondary school Physical Education through a gender-based perception analysis. While prior studies have conceptually discussed the relationship between PE and sustainable development (Fröberg & Lundvall, 2021; Boned-Gómez et al., 2024), limited empirical research has quantitatively examined how students perceive PE's contribution to multiple SDGs simultaneously. Furthermore, this study uniquely combines expert validation (FGD approach) with large-scale student perception data (n = 732), thereby strengthening construct validity and contextual alignment. Another innovative contribution is the identification of specific SDG sub-targets where statistically significant gender differences emerge (e.g., 3.4, 4.2, 4.6, and 5.5). Rather than treating SDGs as a generalized concept, this research disaggregates them into operational educational dimensions, offering a more granular understanding of PE's sustainable development capacity.

This study contributes to the growing body of literature positioning Physical Education (PE) as a transformative sustainability pedagogy. It provides empirical evidence supporting the argument that PE should not be understood merely as a domain of physical fitness, but rather as an interdisciplinary educational platform capable of integrating health promotion, gender equity, cognitive development, and sustainability values within formal schooling. By systematically mapping student perceptions to specific SDG sub-targets, this research extends the discourse on sustainable education beyond its traditional environmental focus and situates PE within broader global development frameworks aligned with Agenda 2030. In doing so, the study strengthens the conceptualization of PE as a strategic contributor to sustainable development rather than a peripheral subject within the curriculum.

From a practical perspective, the findings suggest that PE curricula should explicitly incorporate SDG-aligned learning outcomes to ensure structured integration of sustainability principles into instructional practice. Particular attention should be given to strengthening educational content related to nutrition for vulnerable populations (SDG 2.2) and women's leadership empowerment in sport and physical activity contexts (SDG 5.5), where perception gaps were identified. Professional development initiatives are also essential to equip PE teachers with SDG literacy and gender-responsive pedagogical strategies, enabling them to translate sustainability concepts into meaningful classroom experiences. Furthermore, instructional design may benefit from interdisciplinary approaches that combine numeracy skills, sustainability literacy, and structured physical activity, thereby reinforcing the holistic educational value of PE. At the institutional level, schools and policymakers should recognize PE as a strategic mechanism for advancing SDG achievement rather than treating it as a supplementary or secondary subject within the academic hierarchy.

At the policy level, integrating SDG-related indicators into PE learning assessment frameworks could help align national education systems more closely with Agenda 2030 targets. The present study provides empirical justification for incorporating PE into broader sustainable development reporting and monitoring mechanisms, reinforcing its relevance within educational reform and policy discourse. Despite these contributions, several limitations must be acknowledged. The study relies on self-reported student perceptions, which may be subject to social desirability bias and subjective interpretation. Its cross-sectional design limits the ability to establish causal relationships between PE participation and SDG-related outcomes. Additionally, the research was conducted within a specific regional and cultural context, which may restrict the generalizability of findings to other educational systems or sociocultural settings. The study also did not measure observable behavioral outcomes, such as sustained health behavior changes or actual leadership participation, thereby limiting conclusions about real-world impact.

Future research should therefore employ longitudinal or experimental designs to examine whether positive student perceptions translate into measurable behavioral and developmental outcomes. Intervention-based studies investigating SDG-integrated PE curricula would provide stronger evidence regarding instructional effectiveness. Cross-cultural comparative research is also recommended to explore contextual variability in how PE contributes to sustainable development. Moreover, incorporating teacher perspectives alongside student perceptions would provide a more comprehensive understanding of implementation dynamics. Finally, the development and validation of SDG-based PE assessment instruments would strengthen methodological rigor and enable more standardized evaluation across contexts. Further theoretical exploration may conceptualize PE as a sustainability transformation model embedded within whole-school approaches, thereby expanding its strategic role in advancing global development goals.

## CONCLUSION

The findings demonstrate that Physical Education (PE) plays a significant role in advancing the Sustainable Development Goals (SDGs), particularly those related to health, quality education, and gender equality. Student perceptions indicated that both male and female students held positive views regarding PE's contribution to the SDGs, with only a minor difference in agreement levels. The average scores were 3.86 for males and 3.84 for females, suggesting consensus that PE is fundamental to achieving various SDGs. Further analysis using the Mann-Whitney test revealed no significant difference between male and female perceptions of PE's role in supporting the SDGs ( $U = 64920$ ,  $p\text{-value} = 0.555$ ). These results indicate that both genders share similar views on the importance of PE in furthering the SDGs. In summary, the study demonstrates that Physical Education is important not only for physical health, but also for promoting gender equality, fostering awareness of healthy lifestyles, and enhancing understanding of sustainable development. Despite minor gender differences, both groups recognize Physical Education as an effective means of achieving sustainable development goals, particularly in health, education, and gender equality.

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