MJSS

Akdeniz Spor Bilimleri Dergisi

Mediterranean Journal of Sport Science

ISSN 2667-5463

The Challenges and Strategies for School Physical Education Curriculum and Instruction Under Low Fertility Rates in Taiwan[1]

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DOI: https://doi.org/10.38021asbid.1688547

ORIGINAL ARTICLE

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Abstract

This study investigated the impact of Taiwan's declining student population, driven by low fertility rates, on school physical education curricula and instruction, focusing particularly on rural areas. The research conducted 11 focus group interviews, each comprising multiple stakeholders, with a total of 112 participants including principals, directors, coaches, teachers, and parents from various regions across Taiwan. These interviews provided insights into the challenges and adaptive strategies shaped by this demographic shift. Key issues identified included reduced opportunities for peer interaction, difficulties in forming teams for competitions, and widening disparities between urban and rural schools. In response, schools employed various strategies such as merging grades for activities, modifying competition formats, and emphasizing individual sports to sustain student participation and engagement. Despite the constraints imposed by smaller class sizes, the findings revealed that these challenges may have prompted schools to develop more personalized and collaborative learning environments. The adaptive measures not only mitigated the negative effects of declining enrollments but also encouraged improvement in physical education practices tailored to diverse student needs and developmental levels.

Keywords: Rural Education, Peer Interaction, Urban-Rural Disparities, Thematic Analysis, Focus Group İnterview, Education Policy.

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Tayvan'da Düşük Doğurganlık Oranları Altında Okul Beden Eğitimi Müfredatı ve Öğretimi İçin Zorluklar ve Stratejiler

Öz

Bu çalışma, Tayvan'da düşük doğurganlık oranlarının yol açtığı azalan öğrenci nüfusunun etkilerini incelemiştir. Özellikle kırsal bölgelerdeki okul beden eğitimi müfredatı ve öğretimi üzerinde odaklanmıştır. Araştırma kapsamında, Tayvan'ın farklı bölgelerinden müdürler, yöneticiler, antrenörler, öğretmenler ve veliler olmak üzere toplam 112 kişinin katıldığı, kişi sayısı değişen 11 odak grup görüşmesi yapılmıştır. Araştırmada öne çıkan başlıca sorunlar arasında; akran etkileşimi fırsatlarının azalması, yarışmalar için takım kurma güçlükleri ve kırsal ile kentsel okullar arasındaki eşitsizliklerin artması yer almaktadır. Bu sorunlara karşılık olarak okullar sınıfları birleştirerek ortak etkinlikler düzenleme, yarışma formatlarını değiştirme ve bireysel sporlara odaklanma gibi çeşitli stratejiler geliştirmiştir. Daha küçük sınıf mevcudu gibi kısıtlayıcı koşullara rağmen, elde edilen bulgular bu durumun aynı zamanda okulları daha kişiselleştirilmiş ve işbirliğine dayalı öğrenme ortamları oluşturmaya teşvik etmiş olabileceğini göstermektedir. Uygulanan uyum önlemleri yalnızca azalan öğrenci sayısının olumsuz etkilerini hafifletmekle kalmamış, aynı zamanda beden eğitimi uygulamalarında öğrenci ihtiyaçlarına ve gelişim düzeylerine göre uyarlanmış yöntemleri de teşvik etmiştir.

Anahtar kelimeler: Kırsal Eğitim, Akran Etkileşimi, Kentsel-Kırsal Eşitsizlikler, Tematik Analiz, Odak Grup Görüşmesi, Eğitim Politikası.

Received:
01.05.2025

Accepted:
19.06.2025

Online Publishing:
28.06.2025

[1] The abstract of this research was presented at the 19th FIEPS European congress

Introduction

Low fertility has become a growing concern in many countries around the world. According to the United Nations Department of Economic and Social Affairs (2021), the fertility rate refers to the average number of children a woman is expected to have over her lifetime. Fertility levels are categorized as follows: "high fertility" (5.0 or more births per woman), "intermediate fertility" (between 2.1 and 5.0), and "low fertility" (below 2.1). Low fertility is further broken down into "moderately low" (1.5 to 2.1 births per woman) and "very low" (fewer than 1.5). Since the early 1960s, global fertility rates have declined sharply—from an average of about 5.0 births per woman between 1960 and 1965 to around 3.0 by the early 1990s. In response to this downward trend, by 2019, nearly three-quarters of governments worldwide had implemented policies addressing fertility, with 55 specifically aiming to boost birth rates (UNDESA, 2021).

The impact of low fertility rates on society was profound (Bu & Fee, 2012; Bullinger, 2017; Goh, 2005; Noguchi, 2023; Stefani & Prati, 2024), sparking widespread discussions about its challenges and implications, particularly for the school system (Rosenberg, 2022). As fertility rates decline, schools at all levels must navigate shifting demographics that affect operations, resource allocation, and long-term sustainability. According to Taiwan's Ministry of the Interior (2023), the total fertility rate for women aged 15 to 49 in 2022 was just 0.87 children per woman—a figure that not only falls well below the international threshold for ultra-low fertility but is also significantly lower than that of neighboring countries, including China (1.7), Japan (1.4), and South Korea (1.1) (UNDESA, 2021). Taiwan's fertility rate is among the lowest in the world, underscoring the severity of its demographic decline. As a result, the education sector faces mounting challenges, such as increased administrative burdens, restructuring of class sizes, merging or closing of schools, and adjustments in resource distribution. The shrinking student population has led to reductions in teaching staff, raising concerns about potential impacts on teaching quality, while underutilized school facilities highlight inefficiencies in public resource use. Although smaller class sizes may offer benefits, they can also limit peer interactions and collaborative learning opportunities. In response, governments and educators are exploring policy interventions such as optimizing school resources, adjusting curriculum strategies, and repurposing school spaces. Some institutions are turning to international student recruitment and educational innovation to sustain enrollment and maintain teaching quality. Addressing these challenges requires coordinated efforts from policymakers, schools, and communities to ensure the resilience of the education system in the face of Taiwan's ongoing demographic shifts.

In this context, the school physical education curriculum and instruction are inevitably influenced by declining fertility rates. Compared to sports clubs and school teams, physical education

curricula and instruction involve the largest number of students, making them particularly susceptible to the impacts of a shrinking student population. Besides the curriculum, class-based or inter-school competitions are also affected. These competitions, typically organized by physical education teachers or class tutors, differ in operation from sports clubs and school teams and therefore warrant distinct consideration in discussions about the effects of low fertility.

A key concept for addressing these challenges is physical literacy, first proposed by British scholar Whitehead (2001). In *Physical Literacy Throughout the Life Course*, Whitehead (2010) defines it as an individual's motivation, confidence, physical competence, knowledge, and understanding to sustain lifelong physical activity. In recent years, physical literacy has attracted growing attention in sport education research, both in conceptual debates and for its role in promoting inclusive and adaptive physical education (Corbin, 2016; Jurbala, 2015; Lundvall, 2015; O'Sullivan et al., 2020; Whitehead et al., 2018; Young et al., 2020). Based on previous research (Blain et al., 2021; Coyne et al., 2019; Gu, Chen, et al., 2019; Kaioglou et al., 2020; Kriellaars et al., 2019; Mandigo et al., 2019), physical literacy is recognized as a complex and multidimensional concept that typically includes domains such as motivation and confidence, physical competence, knowledge and understanding, and engagement in physical activities. Correspondingly, a range of assessment approaches has been developed to reflect these dimensions. Commonly used methods include performance-based tests (to measure physical competence and fitness), knowledge-based assessments (such as written or oral tests to evaluate understanding),self-reported questionnaires (to assess motivation, confidence, participation, life skills, daily behaviors, and self-perceived physical literacy), and device-based monitoring tools like pedometers (to track daily activity levels). These varied assessment strategies highlight the need to capture physical literacy from multiple perspectives, as emphasized in earlier studies. In school settings, physical literacy goes beyond organized activities to embrace a broader approach that cultivates cooperative skills and social engagement through innovative teaching methods. This holistic framework aims to ensure that all students can actively participate. It applies regardless of class size or enrollment and encourages collaborative engagement. Integrating physical literacy into curriculum and instructional adaptations may offer schools effective strategies to address social and collaborative challenges arising from declining student numbers and changing competition formats. This study focuses on two key research questions:

1. What challenges does the school physical education curriculum and instruction face in response to the impacts of low fertility?

2. What strategies should be implemented to mitigate these challenges?

This research explored the effects of low fertility on school physical education curriculum and instruction. It also proposed practical strategies to address these challenges. The goal was to inform policy development and improve school practices. By understanding these impacts, the study aimed to help schools adapt to demographic changes while maintaining quality physical education.

Materials and Methods

Data Collection and Participants

The study involved 11 focus group interviews, each lasting approximately 90 minutes and including around 10 stakeholders from various schools. Participants consisted of principals, directors, coaches, teachers, and parents, totaling 112 individuals (84 males and 28 females). The interviews were conducted by the author and colleagues to ensure consistency and reliability in the facilitation process. A semi-structured interview guide was used to prompt discussion on three main areas: the perceived impacts of declining student enrollment on school physical education, the challenges encountered in curriculum and instruction, and the strategies schools have implemented in response.These interviews were conducted across different regions, with 3 sessions held in northern, central, and southern Taiwan, and 1 session each in eastern Taiwan and the outlying islands.

Data Analysis

Following Clarke and Braun (2013), I employed their seven stages of thematic analysis to organize, interpret, and make sense of the key data. These stages include transcription, familiarization with the data, coding, identifying themes, reviewing themes, defining and naming themes, and writing. Once data collection was completed, analysis began with transcription of the collected data, followed by systematic coding using a thematic analysis approach.

The process started with open coding to identify recurring concepts and key issues raised by participants. These initial codes were then grouped into broader themes through axial coding, allowing for a structured analysis of the challenges and adaptive strategies discussed. Finally, selective coding was used to identify the main themes, outlining how low fertility rates affect school physical education and the measures schools have implemented in response.

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The data for this study were derived from 11 focus group interviews conducted across various regions of Taiwan. To indicate regional origin, interviews were coded as follows: N for northern Taiwan, E for eastern Taiwan, C for central Taiwan, S for southern Taiwan, and O for the outlying islands. For example, “S2-36” refers to the second session in southern Taiwan, with “36” indicating the starting line of the transcript at line 36.

Trustworthiness

In determining the credibility of qualitative research results, Lincoln and Guba (1985) suggested that it included credibility, transferability, dependability, and confirmability. The assumption that anyone following the procedures of data collection and analysis would arrive at the same results stemmed from a quantitative research paradigm, which treated the researcher as independent of the study and overlooked the role of the researcher in qualitative research. Yardley (2000) argued that good qualitative research should have included sensitivity to context (theory, literature, sociocultural factors, participants' perspectives, and ethical considerations), commitment and rigour (thorough engagement and methodological competence), transparency and coherence (clear descriptions, transparent methods, and alignment of theory and method), and impact (enhancing theoretical understanding and contributing to sociocultural and practical outcomes). Lichtman (2011) proposed four criteria for evaluating qualitative research: the role of the researcher, successful communication, rich details, and persuasive arguments. Based on these insights (Lichtman, 2011; Lincoln & Guba, 1985; Yardley, 2000), it could be seen that the understanding of qualitative research gradually shifted from a quantitative paradigm to a qualitative paradigm, primarily focusing on whether the process was clearly articulated and whether the researcher's analysis was trustworthy.

The researcher aiming for transparency and coherence in articulating the data collection process and findings. During data collection and analysis, the researcher maintained a neutral stance, avoiding any leading or over-interpretation of participant responses. All procedures adhered to ethical guidelines to ensure data credibility, incorporating personal reflections and continuous cross-checking for enhanced validity.

The researcher is a full-time faculty member at a sport university in Taiwan. I have the academic background required for conducting this qualitative study. My experience in writing and publishing doctoral dissertations and qualitative research papers ensures that I have the skills to analyze and interpret the data, supporting the credibility and rigor of the study’s findings

Results

The Impact of Low Fertility Rate on School Physical Education Curriculum and Instruction

The impact of low fertility rate on school physical education curriculum and instruction can be discussed in the following points:

Decreased Student Numbers Affecting Physical Education Curriculum and Instruction

Due to a decrease in student enrollment, class sizes have become smaller. In some schools, the number of students per class is now in the single digits, especially at the elementary level. This structural change reduces opportunities for peer interaction and group-based activities, limiting the development of key teamwork-related skills such as communication, coordination, inclusiveness, and social participation. These skills are fundamental to the goals of physical education, particularly in promoting physical literacy and collaborative learning. A participant from an elementary school described the challenge of teaching classes with only a few students, making it difficult to plan meaningful activities. For teachers, such conditions constrain the use of traditional team sports and require modifications to teaching content and strategies. Over time, this may impact students' ability to engage in cooperative physical tasks and experience the social dimensions of movement. Moreover, the disparity between large urban schools and smaller rural schools may widen, as the latter face greater challenges in sustaining diverse and inclusive physical education experiences.

> *The school had just over 20 students, and I taught physical education for four years. It was a big challenge, as it was hard to figure out how to teach. I remember being assigned first and second-grade classes, with only two first-graders. I combined the grades, but the total number of students was still fewer than ten (E1-467).*

Many schools with small class sizes adjust their schedules by combining students from different grades in the same time slot. While this helps address the issue of low numbers, it can impact students' learning. Students of varying ages have different cognitive abilities, physical needs, and learning goals, so combining classes may not meet the specific needs of each grade. This makes it challenging for teachers to provide targeted instruction, affecting learning outcomes. Additionally, while cross-grade interactions can foster peer cooperation, poor lesson planning may result in content that is either too simple or too complex, reducing students' engagement and overall learning effectiveness.

> *In fact, peer interaction will inevitably be affected. As the number of students decreases, the challenge of implementing cross-grade teaching becomes even greater. It becomes more difficult to tailor instruction to each student's individual developmental abilities and provide the appropriate attention to each child (E1-105).*

Overall, the decrease in student numbers affects curriculum planning and presents challenges for students' learning and teachers' teaching methods. Fewer opportunities for peer interaction impact teamwork skills. Teachers with small class sizes find it difficult to use traditional teaching methods. When class sizes are too small, teachers must combine students from different grades. This makes teaching more challenging. When there are not enough students to form separate classes, schools use cross-grade teaching. Teachers must adjust instruction based on each student's development. This increases the complexity of teaching.

Decreased Student Numbers Affect Inter-Class Physical Education Activities

The decline in student numbers has significantly affected physical education activities and competitions, both within schools and across schools. Small schools, in particular, face structural limitations in organizing team-based events due to insufficient student numbers. Forming teams for standard competitions such as relay races or ball games has become increasingly difficult, often leading to event cancellations or substantial modifications to competition formats. These changes reduce students' opportunities to engage in cooperative physical activities, which are essential not only for skill development but also for cultivating values such as teamwork, responsibility, and fair play. As a result, students in small schools may experience fewer chances to build group cohesion and class identity through sports. This shift also raises concerns about equity, as students in larger schools are more likely to benefit from a full range of physical education experiences, potentially widening the developmental gap between urban and rural or small-scale schools.

> *The decrease in class sizes indirectly affects many inter-class sports competitions. A clear example is the relay race, which originally required 20 participants. About 10 years ago, the education bureau lowered this requirement to 16 participants (N2-345).*

While cross-grade team formation may appear to be a solution, it is often challenging to implement due to fairness concerns. Students of different ages differ in physical ability, skills, and competitive levels.

> *Due to the declining fertility rates, the number of students per class has dropped significantly. As a result, some inter-class sports competitions can no longer be held. For example, in some schools, classes have only 10 or 20 students, and the number of participants in the relay race has been reduced from 12 to as few as 5 (N2-165)*

This situation limits small schools' participation in physical education and reduces event diversity. Students miss opportunities to develop teamwork, sportsmanship, and collaboration. Schools also face a decline in inter-class competitions, weakening their vitality and diversity.

The Concentration of Students in Urban Areas Hinders Activity Planning

While the declining fertility rate remains a pressing issue across Taiwan, its effects are not evenly distributed due to the concurrent trend of urbanization. As the population increasingly concentrates in major metropolitan areas such as Taipei, New Taipei, Taoyuan, Taichung, Tainan, and Kaohsiung, these cities are now home to approximately 70 percent of Taiwan's population. According to Ministry of the Interior (2023), Taiwan's total population stands about 23,400,000 people, with about 69.77 percent living in the directly governed municipalities. Among these municipalities, New Taipei City has the largest population with over 4 million residents, accounting for 17.29 percent of the total population. Taichung City follows with 2.86 million people, representing 12.22 percent, and Kaohsiung City ranks third with 2.73 million people, or 11.67 percent of the total population. In these urban centers, student enrollment has not declined in proportion to national fertility trends. Some schools have even reported increasing class sizes, a phenomenon largely due to population migration from rural to urban areas. This urban concentration offsets the anticipated demographic decline in cities and complicates educational planning across regions. Urban schools tend to benefit from stable or growing enrollments that support diverse and large-scale physical education programming. In contrast, rural schools face declining participation, reduced activity options, and fewer opportunities for inter-school collaboration. This emerging imbalance raises a critical equity issue regarding the distribution of educational resources and opportunities for physical literacy development throughout Taiwan.

> *Another point I want to address about the low fertility rate is urbanization. The six major metropolitan areas now make up about one-third of Taiwan's population. So, can we say the number of children in these urban areas is decreasing? No. In fact, class sizes are still increasing (C1-179).*

As more families move to urban areas, schools in these regions are not experiencing the same decline in student numbers as small rural schools. The concentration of the population in cities has impacted the organization of physical activities. This has widened the gap between urban and rural areas. In urban areas, student numbers are stable or even growing. This allows schools to offer a wide range of activities and expand the scale of competitions. Students have more opportunities to participate in team sports and large events. This enhances their physical literacy and social interaction. In contrast, rural areas face significant challenges due to decreasing student numbers. Schools often struggle to form teams for group competitions. This leads to a sharp decline in participation. This trend is widening the gap in development opportunities between urban and rural areas. Over time, physical activities in rural areas may shrink. This results in unequal development in students' health and physical literacy.

A Crisis and an Opportunity for Change

Although declining student numbers due to lower fertility rates pose significant challenges, they also present opportunities to improve the quality of physical education. With smaller class sizes, teachers can allocate space, time, and equipment more effectively. This allows for increased student engagement, more individualized instruction, and extended hands-on practice. Participants noted that such conditions can enhance skill acquisition and build student confidence, as learners have more time to participate actively and receive targeted feedback. Some educators view demographic decline not only as a limitation but also as a chance to refine instructional strategies, adjust learning goals to better meet individual needs, and strengthen teacher–student interactions. These adjustments may contribute to improved learning outcomes and the development of physical literacy.

> *I believe we shouldn't see the declining fertility rate as entirely negative. With fewer students in the class, it actually provides an opportunity to offer more to each student and help them develop additional skills (S2-63).*

With fewer students in the class, they have more opportunities to participate in activities, which greatly enhances their practice results. This change is advantageous for improving their skills.

> *In a class of 50 students, each would only get 3 minutes with the ball. Now, with 25 to 30 students, each has 20 to 30 minutes with the ball, greatly improving the teaching experience (N3-430).*

The decline in fertility rates has made teaching methods more refined. Teachers can focus on the needs of each student, leading to more personalized and efficient physical education. With fewer students, teachers can provide more attention and guidance, which improves learning outcomes.

The decline in student numbers due to decreased fertility rates presents both challenges and opportunities for physical education. While smaller class sizes can hinder inter-class competitions and limit student participation in physical activities, they also provide a chance to enhance teaching quality. Teachers can allocate resources more efficiently, giving students more opportunities for hands-on practice and personalized instruction. In urban areas, student numbers remain stable, enabling schools to maintain diverse activities, while rural areas face greater difficulties in organizing events. Despite these challenges, the overall impact of smaller class sizes can lead to more focused instruction, improved student engagement, and better physical skill development.

Strategies for School Physical Education Curriculum and Instruction in Response to Low Fertility Rate

Based on focus group opinions, the low fertility rate impacts school physical education not only by reducing student numbers but also by challenging curriculum, teaching methods, and

competition formats. Participants offered strategies to address these challenges, providing useful insights for government agencies, school administrators, and physical education teachers, outlined as follows:

Adapting Physical Education Curriculum and Instructional Content

To enhance students' teamwork skills, some schools may combine classes. This provides more opportunities for collaboration and creates a competitive learning environment.

> *Actually, our school has been combining classes for quite some time. This approach helps us accommodate activities that require larger groups and ensures that competitions run smoothly. (C3-319)*

When there are not enough participants, the school may expand the grade levels involved and even ask the teachers of combined classes to join the activities to ensure adequate participation.

> *Initially, I organized the curriculum by grade level, but I found it wasn't sufficient. So, we scheduled physical education classes for grades 3-6 at the same time, allowing us to have about 7-8 students in each class. I also asked the teachers to take on different roles: one teacher would lead the lesson, while the other three would join the students, learning alongside them. (E1-85)*

Combining classes gives students valuable opportunities to develop teamwork skills. However, integrating multiple grade levels into the same physical education period ensures smooth activities but creates a challenge for teachers in setting appropriate goals for students with different skill levels.

> *With only 16 students in our entire school, we had to use mixed-grade instruction. However, since each grade level had different learning objectives, it was essential for physical education teachers to set differentiated goals that met the needs of all students. (E1-312)*

Students' developmental differences often limit meaningful practice, especially when mixed grades share a single physical education period. Schools respond by adopting small sided or emerging sports such as tchoukball and modified badminton, in which most learners begin at the same skill level. This level playing field narrows performance gaps, while rule and equipment adjustments add difficulty for older pupils and keep younger ones engaged. Combining classes therefore increases participation and teamwork opportunities, but it also raises instructional demands. Teachers must plan multi level tasks, calibrate drill intensity, and use flexible assessments to ensure that every age group is challenged appropriately. These requirements highlight a need for ongoing professional development in differentiated instruction.

Context matters. In rural schools where enrolment is declining, class combination is often the only way to assemble viable groups. In urban schools with stable numbers, administrators typically rotate timetables or share facilities instead of merging grades. Thus, class combination is primarily a rural strategy, whereas urban schools focus on space management. Across settings, success depends on teachers' capacity to adapt content and on administrative support for continuous training. When these elements align, tailored activities can sustain collaboration, motivation, and skill growth even under the constraints imposed by low fertility.

Revising Inter-Class and Inter-School Competition Rules

In light of the challenges posed by the low fertility rate, many schools began actively adjusting the rules for interclass and interschool competitions to address the issue of limited participation. For example, the number of participants in relay races was reduced to enhance the accessibility and fairness of physical education. This policy change was implemented to ensure that more students could take part in competitions, even in smaller classes. By making this adjustment, schools aimed to allow students to form teams despite having fewer classmates, ensuring that they could still engage in interschool physical education activities and fostering greater inclusivity in school physical education.

> *Our city government quickly implemented this policy, ultimately adjusting the number of participants to 8 male and 8 female participants. I believe this is a policy adjustment made in response to the challenges posed by the low fertility rate (S2-46).*

Inter-class competitions within schools were also adjusted in response to the trend of declining fertility rates, particularly in terms of sports selection and participation numbers. For example, in some smaller schools where the traditional full-court 5-on-5 basketball game was difficult to implement due to lower student enrollment, a half-court 3-on-3 game became an effective alternative. This change not only allowed students to continue enjoying team sports but also enhanced their collaboration and communication skills on the court. These adjustments helped keep school sports activities engaging and made them more inclusive, ultimately encouraging greater student participation.

Sports days were important events for fostering class cohesion and a sense of identity. However, as student numbers declined, many traditional sports day activities could no longer be held in individual schools due to insufficient participation. To adapt to this challenge, schools often had to reduce the number of events, which not only limited the diversity and excitement of the competitions but also deprived students of opportunities to engage in different sports, potentially affecting their interest and skill development. In response, some townships on outlying islands organized joint sports days, bringing together multiple schools to ensure these events could continue.

> *The decline in student numbers had posed a significant challenge for organizing sports days. In Qimei (an island in Penghu), three schools had begun holding joint sports events as early as 2008, recognizing the impact of the declining fertility rate. Around the same time, Jiang'ao Junior High School had also initiated a joint sports day for five schools in Wang'an Township. However, as student enrollment continued to drop over the years, sustaining these events became increasingly difficult. In response, over the past 3 years, the schools had expanded their collaboration, forming an eight-school joint sports day to keep the tradition alive (O1-170).*

In response to the challenges posed by declining fertility rates, schools at various levels have adjusted interclass and interschool competition rules with the aim of maximizing student participation and promoting teamwork and community. Measures such as reducing team sizes, modifying competition formats, and organizing joint events have been implemented to adapt to decreasing student populations while continuing to provide opportunities for engagement in physical activities. Looking ahead, increasing flexibility in competition rules, for example by forming combined teams among smaller schools or organizing contests based on school size, may further enhance participation and cooperation. Sustained effectiveness of these adjustments will depend on ongoing dialogue among educators, administrators, and policymakers to develop policies that are flexible and responsive to differences in school size and regional contexts. Furthermore, provision of appropriate resources and professional development for teachers and coaches is necessary to support the implementation of new competition formats and maintain student involvement. Through collaboration across schools and communities, these efforts can contribute to ensuring that physical education remains inclusive and adaptable to demographic changes, thereby supporting students' physical and social development within an evolving educational environment.

Enhancing Teacher Beliefs and Professional Practice

In the context of declining fertility rates, it is essential for enhancing learning opportunities to adequately prepare teachers for the new challenges they face. For example, in combined-grade classes where students from different age groups are present, physical education teachers must find ways to ensure that lessons meet teaching objectives and effectively address the needs of students at various developmental stages. Teachers need to be equipped with the skills to set differentiated goals, design appropriate teaching activities, and implement effective assessment methods, ensuring they can deliver high-quality instruction in such diverse environments.

> *In one grade period, there was even a sense among students that the support was somewhat lacking. The first issue we questioned was whether the lead teacher and the co-teachers had the necessary skills. For instance, in a single class with students from four different grade*

> *levels, how can we ensure that the physical education lesson meets the teaching objectives? This, I believe, will be a major challenge for physical education teachers in the future. The education department and the county government may need to arrange relevant learning opportunities each year to help these teachers improve their skills (E1-209).*

Professional development initiatives should focus on enriching curriculum design, emphasizing differentiated instructional strategies, and clarifying the timing and application of diverse assessment tools, as combined-grade settings involve varied developmental levels and learning needs that require flexible approaches. Equipping teachers with these skills can enhance instructional quality by enabling them to gather nuanced data through diverse assessments and make timely adjustments that accommodate student heterogeneity, thus preventing disengagement or inadequate challenge. To achieve this, education departments and schools must provide regular, context-specific training that includes collaborative learning and reflective practices, along with ongoing support and resources to ensure lasting impact. This comprehensive approach not only helps teachers maintain effective teaching practices in combined-grade classes but also promotes equity by addressing diverse learner needs, ultimately fostering student engagement, motivation, and skill development in physical education within increasingly heterogeneous classrooms.

Fostering Collaboration Among Schools, Families, and the Community

Given the challenges posed by declining fertility rates, strengthening collaboration among schools, families, and the community is essential to support students' physical and mental development. With fewer children, parents tend to focus more on their child's individual needs. Extending learning opportunities beyond the school environment can improve academic performance. These opportunities also foster greater family involvement and support. Encouraging students to participate in physical activities at school, while reinforcing these habits at home, creates a supportive environment. This promotes their growth and well-being.

> *We encouraged students to practice not only at school but also at home. For example, if the goal was to jump rope 100 times, they were expected to do it both at school and at home. The principal helped coordinate this effort. I believed this approach would be more effective. The impact of physical education extended beyond the classroom when students practiced in both settings, rather than just seeing the teacher as the sole role model for physical activity (C3-450).*

Additionally, if the school has the funding to organize physical activities (including sports experiences and visits to sporting events), parents and students could be invited to participate together. This would help strengthen the connection between the family and the school. Not only would it allow students to enjoy physical activities, but it would also foster positive relationships

between parents and children. This approach would encourage families to become more involved and engaged in their children's education.

> *The school provided funding to bring students to attend a sporting event, which I thought was a great initiative. It also supported the class advisors in taking their students to the event. When we shared this opportunity with the students, one child asked if their parents could also attend……. The main goal was to encourage more people to join, and the response was positive. The teacher reassured the student that it was fine for parents to attend as well (N2-337).*

The school can collaborate with local community sports teams or clubs to organize joint activities and competitions, which not only expands students' opportunities for practical experience but also fosters meaningful engagement among parents and community members. This collaboration serves to bridge the gap between the school and its surrounding community, creating a supportive network that reinforces students' physical and social development. Providing subsidies for community residents to participate when students attend sporting events further encourages family involvement, which research shows can enhance students' motivation and sense of belonging. Such participation deepens parents' understanding of the school's educational philosophy and programming, thereby increasing their support and commitment. Moreover, these interactions contribute to building stronger partnerships between families and schools, which are critical for creating enriched learning environments and promoting holistic student growth. By actively integrating community resources and fostering family engagement, schools can create a more inclusive and collaborative educational ecosystem that benefits all stakeholders.

Discussion

The present findings confirm that Taiwan's declining fertility rate is reshaping physical education in ways already identified by demographic–education scholarship (Bu & Fee, 2012; Rosenberg, 2022). Earlier studies of elementary schools in Japan and South Korea likewise reported that shrinking cohorts compel mixed-grade classes and smaller teaching groups (Noguchi, 2023). Our data echo these patterns and show that physical education is especially exposed because most instructional tasks require a minimum group size. Mixed-age groupings complicated lesson pacing and classroom management, yet they also created opportunities for differentiated instruction that better matches individual readiness levels.

Urban–rural divergence emerged as a salient theme. National surveys of school sport participation found that rural schools were the first to lose extracurricular teams once enrolment fell below critical mass (Bullinger, 2017). Interviews conducted for this study reinforce that conclusion and detail how limited community resources and longer travel times further constrain rural pupils'

access to sport. By contrast, urban schools with steadier numbers continue to operate full-size class, mirroring disparities reported in recent Taiwan statistics from the Ministry of the Interior (2023).

Building on the demographic pressures and urban–rural disparities discussed earlier, this study further contributes to the literature by examining how teachers have responded pedagogically to the challenges posed by the declining fertility rate. Consistent with research on curriculum adaptation and physical literacy (Corbin, 2016; O'Sullivan et al., 2020; Whitehead, 2010). It is recommended that when facing a declining student population, teachers reorganize lesson sequences. They can introduce small-sided or modified games (Coyne et al., 2019; Kriellaars et al., 2019; Mandigo et al., 2019) and incorporate peer assessment as strategies to maintain student engagement in mixed-grade classes. These instructional approaches align with principles found in competency-based curricula, with an emphasis on flexible grouping and formative assessment. Although student numbers are decreasing, the shift toward competency-oriented learning is becoming increasingly important. The development of physical literacy is especially significant (Blain et al., 2021; Gu, Chen, et al., 2019; Kaioglou et al., 2020). Evidence also suggests that adolescents with higher physical literacy exhibit stronger academic performance (Gu, Zhang, et al., 2019).Therefore, curriculum design must continue to prioritize meaningful learning content and students' demonstrated performance. However, many teachers highlighted a lack of preparation time and limited access to professional development. This reveals a gap between policy intentions and the actual support available in practice. This issue has received limited attention in previous quantitative studies and deserves further investigation.

These findings also offer a more nuanced perspective on the widely held belief that smaller class sizes inherently benefit instruction. While reduced group sizes allowed teachers to provide more individualized feedback and skill correction, they also diminished opportunities for teamwork, leadership development, and peer interaction. Teachers expressed concern that with too few students, it becomes increasingly difficult to foster the kinds of social learning that physical education aims to promote. This concern aligns with recent discussions in physical education sociology, which caution against assuming that individualized instruction automatically leads to holistic development (Whitehead et al., 2018). Given that the declining fertility rate is a demographic trend unlikely to reverse in the short term, these challenges are expected to persist and may even intensify. Although teachers have implemented creative strategies in response to demographic change, shrinking class sizes pose ongoing constraints on the collaborative and communicative aspects that are central to physical education.

In summary, Taiwan's declining fertility rate is profoundly reshaping the landscape of physical education, bringing both challenges and opportunities. While smaller cohorts and urban–rural disparities complicate instructional delivery and limit social learning opportunities, they also

prompt innovative pedagogical responses focused on competency-oriented teaching and physical literacy development. To sustain quality physical education amid these demographic shifts, it is essential that policymakers and educators address gaps in professional support and resource allocation. Continued research, particularly with diverse methodological approaches, will be critical to understanding long-term impacts and guiding effective strategies that ensure equitable and holistic physical education for all students in this evolving context.

Conclusion

Low fertility has already altered the fabric of Taiwan's PE programmes and will continue to do so. Mixed-grade teaching, urban–rural inequality, and dwindling extracurricular teams are no longer isolated phenomena but structural trends. Yet these challenges also create openings for instructional innovation and more student-centred practice. Policymakers should prioritise (a) targeted funding that enables rural schools to share facilities and coaching staff, (b) sustained professional-development pathways on mixed-grade pedagogy, and (c) curriculum guidelines that legitimise modified game formats as standard practice. Such measures can help ensure that every student, regardless of location or cohort size, receives equitable and meaningful PE experiences.

Limitation and Future Work

This study has several limitations that warrant consideration. First, the findings are based on qualitative data collected from a limited number of schools, which may not fully reflect the diverse contexts of physical education across Taiwan. The perspectives presented primarily represent PE teachers and administrators, and the absence of student and parent voices limits the understanding of how demographic and instructional changes are perceived by other stakeholders. In addition, this study focused on short-term responses to demographic decline, without examining the long-term effects on student learning or educational equity.

Future research should address these limitations by incorporating larger and more diverse samples to enhance generalizability. Quantitative studies can complement the current findings by measuring the effects of curriculum adjustments on student participation, physical fitness, and learning outcomes. Longitudinal research would also be valuable for examining how sustained changes in class structure and instructional strategies influence students' physical, social, and emotional development. Comparative studies across regions or countries facing similar demographic trends may further clarify which policy responses are most effective in maintaining quality and equity in physical education. Including the perspectives of students, parents, and community members will be essential in future research to inform more inclusive and context-sensitive educational practices.

Disclosure statement

The author declares that there is no conflict of interest.

Academic ethics statement

This study was conducted in accordance with the ethical principles set forth in the Declaration of Helsinki. All participants were fully informed about the study's objectives, the voluntary nature of their involvement, and their right to withdraw at any time without consequence. Informed consent was obtained from all participants prior to the commencement of the study. While formal approval from an ethics committee was not required for this study, the author assumes full responsibility for ensuring that ethical standards were upheld throughout the research process.

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