



Effectiveness of an Aquatic Play-Based Learning Program on Improving Water Confidence and Fundamental Aquatic Skills in Children Aged 4-7 Years

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Abstrac: This study aims to systematically analyze various physical training approaches in athletics. This research employed a systematic review. Article searches were conducted across five electronic databases: Google Scholar, PubMed, ScienceDirect, SPORTDiscus, and Directory of Open Access Journals (DOAJ), covering publications from 2013 to 2024. Inclusion criteria encompassed original research articles, systematic reviews, and meta-analyses discussing physical training in athletics. Data extraction and synthesis were performed thematically. From 47 articles meeting the inclusion criteria, six major training strategies were identified: (1) High-Intensity Interval Training (HIIT) and Sprint Interval Training (SIT) for improving VO₂max and running economy; (2) Circuit training for cardiovascular endurance; (3) Plyometric training for explosive power development; (4) Sport-specific strength training for throwing events; (5) Periodization approaches for long-term training load management; and (6) Integration of wearable technology for real-time performance monitoring. The findings indicate that combined training approaches generally yield superior results compared to single-method interventions.

Keyword: Physical Training, Athletics, Systematic Review, Periodization, HIIT, Evidence-Based Practice

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INTRODUCTION

The acquisition of fundamental swimming skills during early childhood represents a critical component of motor development, water safety preparedness, and self-confidence formation (WHO, 2017; American Red Cross, 2014). Children aged 4-7 years are at a crucial stage of fundamental motor development that significantly influences movement quality in subsequent years. Swimming instruction at this stage should not merely focus on technical mastery but also emphasize water environment adaptation, psychological strengthening, and the creation of enjoyable learning experiences (Triyana, 2021).

Swimming as an aquatic sport possesses unique characteristics because it occurs in a medium fundamentally different from everyday movement environments (Maglischo, 2003). Consequently, beginner children often experience anxiety or fear of water that can impede the learning process. Water confidence serves as the primary foundation before children can master fundamental movement skills such as floating, gliding, breathing control, and coordination of arm and leg movements (Dewi, 2023). Without a strong psychological foundation, technical swimming instruction will not achieve optimal results (Dewi & Ilmy, 2021).

Fundamental aquatic skills in young children are closely related to the development of coordination, balance, basic strength, and breathing control (Sharp, 2010). The Indonesian National Competency Standard for Basic Swimming (BSN, 2022) emphasizes that initial swimming instruction should focus on mastering fundamental aquatic skills before progressing to specific stroke techniques. In the context of sports development, periodization principles and training progression must also consider the child's age and biological readiness (Bompa & Haff, 2009; Bompa & Buzzichelli, 2015).

Previous research has demonstrated that learning models have a significant relationship with the level of basic freestyle swimming technique mastery (Dewi & Budiman, 2025). Furthermore, systematic learning approaches have proven effective in improving freestyle swimming learning outcomes (Dewi & Rusmayani, 2025). However, most approaches employed remain oriented toward conventional technique and drill methods, which sometimes inadequately address the psychological characteristics of young children who require playful and exploratory learning environments.

The Aquatic Play-Based Learning approach emerges as an innovative alternative in children's swimming pedagogy. This model positions water play as the primary learning medium, designed systematically to develop sensorimotor skills, water environment adaptation, and children's self-confidence. Play-based learning has proven effective in enhancing motivation, engagement, and meaningful learning experiences (Naser, 2019). In the swimming context, water play activities can be designed to train breathing control, body balance, movement coordination, and progressive readiness for fundamental techniques (Dewi, 2023).

From physiological and biomechanical perspectives, movement in water requires adjustment to buoyancy forces, resistance, and rhythmic coordination between arms and legs (Maglischo, 2003; Sharp, 2010). Therefore, a progressive play approach can help children understand buoyancy concepts and water resistance naturally through direct experience. Research related to strength and coordination training in swimming has also shown that developmentally appropriate approaches significantly impact basic performance improvement (Dewi et al., 2022; Negara et al., 2023).

This study was conducted with 22 beginner participants at Tirta Krisna Swimming Club, comprising 3 children aged 4 years, 6 children aged 5 years, 8 children aged 6 years, and 5 children aged 7 years, with 9 female and 13 male participants. This heterogeneous characteristic reflects real-world conditions in beginner swimming instruction at clubs, necessitating an adaptive, enjoyable, and effective learning model for this entire age range.

Although various studies have examined swimming technique learning, empirical research specifically investigating the effectiveness of Aquatic Play-Based Learning programs on improving water confidence and fundamental aquatic skills among children aged 4-7 years remains relatively limited, particularly within the context of Indonesian swimming clubs. Therefore, this study aims to analyze the effectiveness of an Aquatic Play-Based Learning program in enhancing water confidence and fundamental aquatic skills in children aged 4-7 years.

The findings are expected to provide theoretical contributions to the development of innovative children's swimming learning models and practical contributions for coaches and sports education institutions in designing more effective, safe, and enjoyable instruction aligned with early childhood developmental characteristics.

METHOD

Research Design

This study employed a quasi-experimental design with a pretest-posttest one-group design. This design was selected because all participants were beginner members within a single learning group at Tirta Krisna Swimming Club, making the formation of a separate control group impractical. In this design, all participants first received baseline measurements (pretest) to determine initial levels of water confidence and fundamental aquatic skills before receiving the intervention. Subsequently, participants completed the Aquatic Play-Based Learning program intervention, followed by posttest measurements to analyze changes and improvements after program implementation. This design enabled researchers to directly evaluate the effectiveness of play-based aquatic learning in the context of early childhood swimming development.

Participants

The research participants consisted of 22 beginner-level children aged 4-7 years at Tirta Krisna Swimming Club. The participant composition included 3 children aged 4 years, 6 children aged 5 years, 8 children aged 6 years, and 5 children aged 7 years, with 9 female and 13 male participants. Total sampling technique was employed, as all beginner members participating in the program during the research period were included as study subjects. The heterogeneous characteristics in terms of age and gender reflect real-world conditions in beginner swimming instruction at clubs, ensuring that research findings possess practical relevance for early childhood swimming development.

Variables and Instruments

The independent variable in this study was the Aquatic Play-Based Learning program, while the dependent variables comprised water confidence and fundamental aquatic skills. Water confidence was measured using an observational scale developed by the researchers based on concepts of water environment adaptation and children's sport psychology (Dewi & Ilmy, 2021; WHO, 2017). Measurement indicators included willingness to enter water, ability to submerge the face, calmness while floating, response to instructor guidance, willingness to attempt new movements, and positive emotional expression during learning. The scale employed a 1-4 rating range. Content validity was assessed through expert judgment by sports education specialists and swimming coaches, while reliability was tested using Cronbach's alpha coefficient to ensure internal consistency.

Fundamental aquatic skills were assessed using a performance rubric referencing the Indonesian National Competency Standard for Basic Swimming (BSN, 2022), fundamental aquatic skills concepts (Maglischo, 2003), and beginner swimming pedagogy (Triyana, 2021; Dewi, 2023). Assessed indicators included water adaptation, floating ability, gliding, breathing control, and basic arm and leg coordination. Each indicator was rated on a 1-4 scale based on movement execution quality.

Intervention Procedure

The research procedure was implemented through several stages. The first stage involved preparation, including development of Aquatic Play-Based Learning program materials, instrument validation, and coordination with coaches and participants' parents. The second stage involved pretest administration to measure baseline water confidence and fundamental aquatic skills. The third stage comprised the intervention through the Aquatic Play-Based Learning program delivered across 12 learning sessions with 45-60 minutes duration per session.

The program was designed progressively with the following stages: water adaptation games, balance and buoyancy games, breathing control games, basic movement coordination games, and combined movement games. The learning approach emphasized fun-based learning principles, safety according to WHO (2017) and American Red Cross (2014) guidelines, and appropriateness for children's developmental stages and early childhood training periodization

principles (Bompa & Haff, 2009). After all intervention sessions were completed, posttest measurements were conducted to determine changes and improvements in both research variables.

Data Analysis

Data analysis was conducted using SPSS version 23.0. Analysis stages included normality testing using Shapiro-Wilk, followed by paired sample t-test to determine differences between pretest and posttest scores for water confidence and fundamental aquatic skills variables. Additionally, effect size values (Cohen's *d*) were calculated to determine the magnitude of program influence on improvements in both variables. The significance level used in this study was $\alpha = 0.05$. All research procedures were conducted with attention to research ethics, including parental consent through informed consent and implementation of water safety standards throughout the learning process.

RESULT

Descriptive Data

This study was conducted at Tirta Krisna Swimming Club involving 22 beginner participants aged 4-7 years. The participant composition consisted of 3 children aged 4 years, 6 children aged 5 years, 8 children aged 6 years, and 5 children aged 7 years. Based on gender, there were 9 female and 13 male participants. All participants completed the Aquatic Play-Based Learning program across 12 learning sessions.

To determine program effectiveness in improving water confidence and fundamental aquatic skills, pretest and posttest data analysis was conducted. Calculations of mean values, standard deviations, and variances are presented in the following tables.

Table 1. Mean, Standard Deviation, and Variance of Water Confidence (n = 22)

Test Period	Mean	Standard Deviation	Variance
Pretest	62.14	7.62	58.06
Posttest	79.27	6.85	46.92

Table 2. Mean, Standard Deviation, and Variance of Fundamental Aquatic Skills (n = 22)

Test Period	Mean	Standard Deviation	Variance
Pretest	58.27	8.12	65.93
Posttest	76.91	7.38	54.46

Based on Table 1 and Table 2, significant improvements were observed after implementation of the Aquatic Play-Based Learning program. Mean water confidence increased by 17.13 points, while fundamental aquatic skills increased by 18.09 points. The decrease in standard deviation values for both variables indicates that participant abilities became more uniform after participating in the play-based aquatic learning program.

When examined by age group, the most prominent improvements were observed in the 4-5 year age group for water confidence aspects, while the 6-7 year age group showed greater improvements in basic movement coordination. Based on gender, both male and female participants demonstrated relatively balanced improvements after the intervention.

Normality Testing

Before hypothesis testing, normality testing was conducted using Shapiro-Wilk because the sample size was less than 50. Results indicated that water confidence data for pretest ($p = 0.327$) and posttest ($p = 0.418$) were normally distributed ($p > 0.05$). Similarly, for fundamental aquatic skills variable, pretest ($p = 0.294$) and posttest ($p = 0.365$) also showed normal distribution. Thus, data met normality assumptions and could be analyzed using parametric tests.

Hypothesis Testing

Hypothesis testing was conducted using paired sample t-test to determine differences between pretest and posttest scores for each variable.

Table 3. Paired Sample t-test for Water Confidence (n = 22)

t-value	Sig. (2-tailed)	Result	Conclusion
8.736	0.000	H ₀ Rejected	Significant effect

Results indicated a significant increase in water confidence after participating in the Aquatic Play-Based Learning program ($p < 0.05$).

Table 4. Paired Sample t-test for Fundamental Aquatic Skills (n = 22)

t-value	Sig. (2-tailed)	Result	Conclusion
9.284	0.000	H ₀ Rejected	Significant effect

Results indicated a significant increase in fundamental aquatic skills after the intervention ($p < 0.05$). Effect size calculation (Cohen's d) showed values of 1.80 for water confidence and 1.95 for fundamental aquatic skills, both categorized as large effects. This demonstrates that the Aquatic Play-Based Learning program had a strong influence on improvements in both research variables. Overall, results indicate that the Aquatic Play-Based Learning program was effective in improving water confidence and fundamental aquatic skills among 22 beginner participants aged 4-7 years at Tirta Krisna Swimming Club, for both male and female participants.

DISCUSSION

The findings of this study demonstrate significant improvements in both water confidence and fundamental aquatic skills among children aged 4-7 years following participation in the Aquatic Play-Based Learning program. These results align with contemporary understanding of early childhood motor development and the critical role of affective factors in aquatic skill acquisition.

Mechanisms of Aquatic Play-Based Learning Effectiveness

The effectiveness of the Aquatic Play-Based Learning approach can be explained through three interconnected mechanisms. First, the play-based nature of the program creates an emotionally safe learning environment that reduces anxiety and fear commonly associated with water immersion in young children. Research by Naser (2019) supports this notion, demonstrating that playful learning contexts significantly enhance motivation and engagement in children's aquatic activities. When children perceive swimming lessons as play rather than formal instruction, their psychological barriers diminish, allowing for more natural exploration of water properties.

Second, the progressive structure of the program - moving from water adaptation games to balance and buoyancy activities, then to breathing control and coordination exercises - aligns with established principles of motor learning and developmental readiness. This sequential approach mirrors the natural progression of aquatic skill development described by Maglischo (2003) and Sharp (2010), where foundational comfort in water precedes technical skill acquisition. The large effect sizes observed ($d = 1.80$ and 1.95) suggest that this structured progression is particularly effective for this age group.

Third, the simultaneous development of water confidence and fundamental skills creates positive feedback loops. As children become more comfortable in water through playful activities, they are more willing to attempt new movements, which in turn builds confidence. This reciprocal relationship between affective and motor domains has been documented in previous research on children's aquatic development (Dewi & Ilmy, 2021).

Age-Related Differences in Response to the Program

The observation that younger children (4-5 years) showed the most prominent improvements in water confidence, while older children (6-7 years) demonstrated greater gains in movement coordination, reflects developmental differences in learning readiness. Younger children are at a critical period for emotional bonding with water environments, making them particularly responsive to play-based approaches that emphasize enjoyment and exploration.

Conversely, older children possess more developed neuromuscular systems that enable them to benefit more from coordination-focused activities.

These findings have important implications for swimming instructors working with mixed-age groups. The Aquatic Play-Based Learning framework provides sufficient flexibility to accommodate varying developmental levels within a single instructional setting, making it practical for real-world swimming club operations.

Theoretical and Practical Implications

From a theoretical perspective, this study contributes to the growing body of literature supporting holistic approaches to early childhood aquatic education. The integration of psychological (water confidence) and motor (fundamental skills) outcomes within a single pedagogical framework aligns with contemporary theories of motor development that emphasize the interconnectedness of affective, cognitive, and physical domains (Bompa & Haff, 2009). The novelty of this research lies in demonstrating that structured aquatic play can effectively address both domains simultaneously within a swimming club context.

Practically, these findings suggest that swimming clubs and aquatic facilities serving young children should consider adopting play-based approaches rather than traditional technique-focused instruction for beginner levels. The large effect sizes observed indicate that such programs can produce meaningful improvements in relatively short timeframes (12 sessions), making them efficient as well as effective. Furthermore, the balanced improvements across genders suggest that Aquatic Play-Based Learning is appropriate for diverse participant populations.

Safety and Developmental Appropriateness

The emphasis on fun-based learning within a structured safety framework addresses both the psychological and physical welfare of young participants. By following WHO (2017) and American Red Cross (2014) safety guidelines, the program ensures that playful activities do not compromise safety standards. This balance is crucial for maintaining parent confidence and program sustainability. Additionally, the alignment with periodization principles for early childhood training (Bompa & Buzzichelli, 2015) ensures that the program does not impose excessive physical demands on developing bodies. The progressive nature of the activities allows for gradual adaptation, reducing injury risk while promoting long-term enjoyment of aquatic activities.

Limitations and Future Directions

Several limitations should be acknowledged. The absence of a control group limits causal inference, as improvements could potentially be attributed to maturation effects or repeated testing rather than the intervention itself. Additionally, the relatively small sample size ($n = 22$) and single-club setting may limit generalizability to broader populations.

Future research should consider randomized controlled designs with larger, multi-site samples to strengthen evidence for program effectiveness. Longitudinal studies tracking participants over extended periods would also be valuable for understanding the long-term impact of early aquatic play experiences on swimming skill development and water safety behaviors. Furthermore, investigation of specific program components could help identify which elements contribute most significantly to observed outcomes.

CONCLUSION

The Aquatic Play-Based Learning program demonstrated significant effectiveness in improving both water confidence and fundamental aquatic skills among children aged 4-7 years at Tirta Krisna Swimming Club. Statistical analysis revealed significant increases in both variables ($p < 0.05$), with large effect sizes (Cohen's $d = 1.80$ for water confidence and 1.95 for fundamental aquatic skills), indicating that the program produced meaningful and substantial improvements.

Theoretically, this study contributes to aquatic pedagogy literature by demonstrating that structured play-based approaches can simultaneously address both affective and motor domains

in early childhood swimming instruction. The integration of water confidence development with fundamental skill acquisition within a unified pedagogical framework represents a significant advancement over traditional technique-focused approaches that often neglect psychological readiness.

Practically, these findings provide valuable guidance for swimming coaches, aquatic facility managers, and sports education institutions seeking to develop effective beginner programs for young children. The Aquatic Play-Based Learning model offers a developmentally appropriate, engaging, and safe alternative to conventional swimming instruction that aligns with contemporary understanding of early childhood motor development and learning.

Based on these findings, the following recommendations are proposed: (1) swimming clubs should consider implementing Aquatic Play-Based Learning approaches for beginner-level children's programs; (2) instructor training should emphasize the importance of creating enjoyable, low-pressure learning environments that prioritize water confidence alongside technical skills; and (3) future research should expand investigation to larger, more diverse samples and include longitudinal designs to assess long-term program impacts.

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