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(IJEPC)**www.ijepec.com**ENHANCING PHYSICAL FITNESS OF STUDENTS WITH
SPECIAL NEEDS THROUGH STRUCTURED AQUATIC
PROGRAMS: A QUANTITATIVE INTERVENTION STUDY**Eshelvana Elve Irin¹, Syuhadah Othman², Aisyah Zainudin³, Mohamad Nizam Nazarudin^{4*}¹ Faculty of Education, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia
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DOI: 10.35631/IJEPC.1061019**Abstract:**

Physical fitness is a fundamental determinant of health and functional independence, particularly for individuals with special needs who often face barriers to physical activity. Aquatic environments offer unique therapeutic and educational advantages, yet structured aquatic interventions remain underexplored within Malaysian special education contexts. This study aimed to investigate the effectiveness of a structured aquatic program in enhancing muscle strength, balance, and coordination among students with special needs, and to assess the sustainability of these improvements over time. A quasi-experimental single-group pre-test–post-test design was employed involving four students (N = 4) from a Malaysian special education center. The 12-week aquatic program was based on the Halliwick Concept and Aquatic Sensory Integration Framework, with three evaluation phases: pre-test, post-test, and post-test 2 (follow-up). Performance was assessed through push and glide, floating, bubble jump, and flutter kick tests. Data were analysed descriptively and supported by observational records. Significant improvements were observed across all components, particularly in propulsion, balance, and endurance. Average gains ranged from 80% to 120%, with retention exceeding 80% during the follow-up phase. Participants also demonstrated increased confidence, motivation, and water adaptability. The structured aquatic program effectively enhanced physical fitness and sustained motor performance among students with special needs. The findings support



the integration of aquatic-based interventions into Malaysia's inclusive education framework as a pedagogical and rehabilitative strategy promoting lifelong participation and wellbeing

Keywords:

Aquatic Therapy, Special Needs Education, Physical Fitness, Motor Learning, Inclusive Physical Education, Halliwick Concept

Introduction

Physical fitness forms a cornerstone of holistic human development, influencing not only the body's capacity for movement but also emotional balance, cognitive functioning, and social well-being. It embodies a synthesis of muscular strength, endurance, flexibility, balance, and coordination, all of which are essential for independence and a high quality of life. However, for individuals with special needs, maintaining physical fitness poses a multifaceted challenge. Their participation in physical activity is often constrained by neuromotor impairments, restricted access to facilities, or a lack of inclusive programming within formal education systems (Scanlon & Doyle, 2022). As conventional physical education (PE) tends to emphasize competition and standard performance metrics, learners with disabilities are frequently excluded or marginalized. This imbalance signals an urgent need for innovative, adaptive, and evidence-based models of physical activity that respect individual diversity while fostering inclusion and functional capability.

Globally, the role of physical education has evolved from a purely performance-based model toward a more humanistic and inclusive paradigm. The World Health Organization (WHO) and various international frameworks now position inclusive PE as an essential vehicle for achieving equity in health and education. The emphasis has shifted from "sport for performance" to "movement for development," recognizing physical activity as both a health determinant and a social right. Within this paradigm, aquatic environments have gained increasing recognition for their accessibility, adaptability, and therapeutic potential. The unique physical properties of water, particularly buoyancy, hydrostatic pressure, and viscosity, create a low-impact medium that facilitates movement, supports body weight, and reduces joint stress, making it ideal for individuals with restricted mobility (Heath & Pataky, 2024).

Aquatic interventions offer sensory-rich and emotionally supportive environments that enable learners to develop motor skills, confidence, and body awareness in a safe and motivating context. Research consistently affirms that aquatic-based activities contribute to improved muscle strength, flexibility, balance, and motor coordination, particularly for individuals with cerebral palsy, Down syndrome, and autism spectrum disorder (Scott et al., 2020; Karpov et al., 2021). These programs also enhance psychological outcomes such as self-efficacy and emotional regulation, reinforcing their relevance as both educational and rehabilitative strategies (Caputo et al., 2018).

Among the most established frameworks supporting aquatic education for individuals with disabilities is the Halliwick Concept. Developed as a structured approach to progressive skill development in water, this concept integrates principles from psychology, biomechanics, and motor learning (Roj et al., 2016). It emphasizes balance control, rotational movement, and breath regulation to help participants achieve independence in water. Through this process,

learners not only develop physical competence but also experience confidence, enjoyment, and autonomy, critical factors for sustained participation in physical activity. Complementary to this, Aquatic Sensory Integration models address sensory processing and behavioural adaptation, which can be particularly challenging for individuals with neurodevelopmental conditions. As Botha et al. (2025) note, group-based aquatic sessions create emotionally safe spaces that strengthen peer relationships, foster cooperation, and enhance social engagement.

From a biomechanical and therapeutic perspective, aquatic exercise offers resistance-based training that is conducive to neuromuscular adaptation. The viscosity of water allows controlled, multidirectional resistance that strengthens muscle groups and improves balance and proprioception without overloading joints (Ma et al., 2025). Moreover, the aquatic setting promotes cardiovascular endurance and supports the rehabilitation of patients recovering from neurological or musculoskeletal conditions (Oh & Lee, 2021). The integration of these physiological and psychosocial benefits positions aquatic activity as a uniquely holistic form of intervention. It operates simultaneously as therapy, education, and empowerment — a triad particularly valuable for individuals with special needs, whose challenges often span multiple developmental domains.

In the global context, evidence of aquatic therapy's efficacy continues to accumulate. Studies conducted across Europe and Asia have documented marked improvements in physical performance, emotional well-being, and adaptive behavior following structured aquatic programs (Caputo et al., 2018; Karpov et al., 2021; Ma et al., 2025). These outcomes align with the theoretical underpinnings of Social Cognitive Theory, which highlights learning through observation and reinforcement (Bandura, 1985), and Self-Determination Theory, which emphasizes autonomy, competence, and relatedness as key drivers of motivation (Deci & Ryan, 2000). The aquatic environment, characterized by freedom of movement and playful engagement, effectively fulfills these conditions, encouraging persistence, intrinsic motivation, and enjoyment in physical activity.

Despite the robust international evidence, the Malaysian context reflects a different reality. While national policies advocate inclusive education, implementation gaps persist, particularly in the domain of adapted physical education. Access to aquatic facilities remains limited to urban centers, and teacher preparation programs rarely include specialized training in aquatic instruction. As Marinho-Buzelli et al. (2019) and Heath and Pataky (2024) observed, inadequate infrastructure and limited accessibility continue to restrict program availability for students with disabilities. Furthermore, the existing body of local research remains scarce, leaving a void in empirical understanding of how aquatic programs can be adapted to Malaysia's educational and sociocultural environment.

This gap extends beyond facilities; it encompasses pedagogical and systemic challenges. Many schools emphasize classroom-based skill development, often neglecting the physical and therapeutic dimensions that are essential for comprehensive growth. Teachers often lack access to professional development or practical frameworks, such as the Universal Design for Learning (UDL) model, that could support individualized and flexible instruction in aquatic settings. Consequently, there is a pressing need for locally grounded research that not only measures outcomes but also contextualizes the process of delivering aquatic education within Malaysia's inclusive education framework.

In response to this gap, the present study aims to evaluate the effectiveness of a structured aquatic program specifically designed for students with special needs. The intervention is grounded in Motor Learning Theory and Biomechanical Theory, emphasizing repetitive, skill-based movement patterns facilitated through water's unique physical properties. Simultaneously, the program aligns with UDL principles, ensuring accessibility, flexibility, and engagement for all participants. By measuring changes in muscle strength, balance, and motor coordination, the study aims to generate quantitative evidence of improvement and sustained functional gains.

Beyond measurable outcomes, the study also aspires to demonstrate how aquatic programs can serve as platforms for empowerment and inclusion. In doing so, it seeks to contribute to the broader discourse on adaptive physical education and inclusive wellbeing. Ultimately, this research aligns with Malaysia's commitment to equity in education and health, offering a model that merges therapy with learning, science with empathy, and movement with meaning. By bridging global knowledge and local practice, it positions aquatic-based physical activity as both a pedagogical and rehabilitative strategy capable of transforming not only physical ability but also confidence, motivation, and quality of life among individuals with special needs.

Problem Statement

Despite strong global evidence supporting the benefits of aquatic-based interventions for individuals with disabilities, the translation of these programs into the Malaysian educational and therapeutic landscape remains limited. While research in other countries has demonstrated significant improvements in muscle strength, balance, motor coordination, and psychosocial well-being through structured aquatic programs (Caputo et al., 2018; Scott et al., 2020; Botha et al., 2025), similar empirical investigations within Malaysia are scarce. Schools and special education centers often lack the necessary facilities, trained instructors, and structured curricula to effectively implement such programs (Marinho-Buzelli et al., 2019; Heath & Pataky, 2024). Consequently, students with special needs are deprived of inclusive opportunities that could meaningfully enhance their physical fitness and self-efficacy.

Current practices in Malaysian special education still rely heavily on land-based or classroom-oriented activities that may not fully accommodate the physical and sensory needs of learners with disabilities. This misalignment between educational policy and practical delivery underscores a significant gap in the application of inclusive physical education. Moreover, limited research evidence constrains educators and policymakers from developing targeted interventions or allocating appropriate resources. Therefore, there is a pressing need to evaluate the effectiveness of structured aquatic programs in enhancing physical fitness, particularly in terms of muscle strength, coordination, and balance, among students with special needs. Addressing this gap will not only contribute to the body of knowledge in adaptive physical education but also support Malaysia's broader agenda of inclusive education and equitable wellbeing.

Research Objectives and Questions

The central focus of this study is to examine the effectiveness of a structured aquatic program in improving selected components of physical fitness among students with special needs. Guided by principles of Motor Learning Theory, Biomechanical Theory, and the Universal Design for Learning (UDL) framework, the study is designed to provide empirical evidence on

how aquatic environments can enhance physical, functional, and psychosocial outcomes in inclusive education contexts. Previous studies have demonstrated that aquatic-based programs effectively promote motor coordination, balance, and confidence among individuals with neurological and developmental impairments (Caputo et al., 2018; Scott et al., 2020; Botha et al., 2025). However, such evidence remains largely unexplored within the Malaysian special education landscape, where systemic, infrastructural, and instructional challenges persist (Marinho-Buzelli et al., 2019; Heath & Pataky, 2024).

Accordingly, the objectives of this study are as follows:

1. To evaluate the effectiveness of a structured aquatic program in improving muscle strength, coordination, and balance among students with special needs.
2. To observe whether the physical fitness improvements achieved through the aquatic program are sustained over time.

Based on these objectives, the study seeks to answer the following research questions:

1. How effective is the structured aquatic program in improving muscle strength, coordination, and balance among students with special needs?
2. Are the improvements in physical fitness components maintained after the intervention period?

Methodology

Research Design

This study employed a quasi-experimental single-group pre-test–post-test design to examine the effectiveness of a structured aquatic program in improving physical fitness among students with special needs. The design was chosen for its suitability in educational and therapeutic settings where randomization and control groups are often not feasible due to ethical and logistical considerations (Roj et al., 2016). The intervention was implemented over a 12-week period, incorporating three testing phases: pre-test, post-test, and post-test 2 (follow-up) to measure both immediate and sustained improvements in physical performance. This design enabled the observation of changes in motor capability over time and the evaluation of retention effects following the intervention (Scott et al., 2020).

Participants

The study involved four ($N = 4$) students with special needs, purposively selected from a Malaysian special education center. Inclusion criteria required that participants:

1. Possessed medical clearance to engage in aquatic activity;
2. Demonstrated basic water adjustment ability; and
3. Were able to follow verbal or visual instructions during sessions.

Students with acute medical conditions, severe behavioral challenges, or a fear of water were excluded to ensure safety and consistency of participation (Marinho-Buzelli et al., 2019). Parental consent was obtained prior to the study, and all procedures were conducted in accordance with ethical standards for research involving vulnerable populations.

Intervention Procedure

The aquatic program was structured based on the Halliwick Concept and Aquatic Sensory Integration Framework, integrating principles of Motor Learning and Biomechanics (Roj et al., 2016; Caputo et al., 2018). Each session lasted 60 minutes and was conducted three times per week over 12 consecutive weeks. The intervention followed four progressive stages:

1. Water Familiarization and Adjustment – Focused on orientation, breath control, and buoyancy adaptation;
2. Static Balance and Core Stability – Introduced controlled floating, balance recovery, and postural alignment;
3. Dynamic Movement Control – Emphasized push-and-glide, flutter kick, and underwater propulsion;
4. Skill Integration and Endurance – Combined learned movements into functional sequences for improved coordination and endurance.

All sessions were supervised by certified aquatic instructors trained in adaptive physical education, ensuring consistent technique application and participant safety. The program emphasized individualized feedback, repetition, and gradual progression to optimize motor learning and confidence development (Botha et al., 2025; Ma et al., 2025).

Instruments and Measurement

Four performance-based fitness indicators, as in Table 1, were selected to assess improvements in muscle strength, coordination, and balance:

Table 1. Performance-Based Fitness Indicators

Test	Measured Component	Description
Push and Glide Test	Lower-limb power & balance	Participants pushed off the pool wall and glided, covering a certain distance and maintaining stability.
Floating Test	Core strength & buoyancy control	Participants maintained a horizontal floating position for maximum duration.
Bubble Jump Test	Respiratory control & water confidence	Participants performed controlled breathing while submerging and jumping.
Flutter Kick Test	Leg endurance & coordination	Assessed continuous kicking rhythm and propulsion distance.

All assessments were conducted under standardized pool conditions by the same examiner to ensure reliability and measurement consistency (Heath & Pataky, 2024).

Validity and Reliability

To ensure instrument validity, all physical tests were adapted from internationally recognized aquatic motor assessment protocols previously validated in rehabilitation and adapted PE contexts (Caputo et al., 2018; Scott et al., 2020). Content validity was verified through expert review by three specialists in adapted physical education and aquatic therapy, who confirmed that each test appropriately measured the intended component (strength, coordination, or balance). Minor modifications were made to accommodate the physical characteristics and safety needs of Malaysian students with special educational needs. Construct validity was reinforced by aligning each performance indicator with the theoretical underpinnings of Motor

Learning Theory and Biomechanics, ensuring that observed improvements directly reflected motor acquisition and physical function (Roj et al., 2016; Ma et al., 2025).

Reliability was established through test–retest procedures and intra-rater consistency. All tests were conducted twice during pilot sessions to confirm the stability of measurement outcomes. The same examiner administered all assessments to minimize variability and ensure procedural consistency. Observed consistency exceeded 0.85 in inter-session agreement, indicating high reliability. The controlled aquatic environment further minimized external factors that could influence measurement, ensuring dependable replication of results (Heath & Pataky, 2024).

Data Collection and Analysis

Quantitative data were collected across the three testing phases (pre-test, post-test, and post-test 2). Performance observations were recorded in meters, seconds, and qualitative descriptors of stability and coordination. Data were analysed using descriptive statistics to illustrate mean differences and percentage changes in physical performance components. The progression across test phases was used to evaluate both the effectiveness and sustainability of the aquatic intervention (Scott et al., 2020; Botha et al., 2025). Qualitative field notes were also maintained to contextualize participants' emotional and behavioural responses, offering interpretive support for the quantitative findings. This mixed descriptive-quantitative approach aligns with the inclusive and human-centered nature of adapted physical education research (Caputo et al., 2018).

Ethical Considerations

Ethical clearance was obtained from the Institutional Review Board of the host university and the respective special education center. Informed consent was obtained from parents and guardians, ensuring that participants' rights to privacy, safety, and voluntary participation were respected. All aquatic sessions adhered to standard safety protocols and were conducted in the presence of qualified instructors and lifeguards. Participants were permitted to withdraw from the program at any time without penalty or consequence. This methodology was specifically designed to measure the effectiveness of a structured aquatic program in enhancing the physical fitness of students with special needs within a controlled, inclusive, and ethically sound framework. The integration of biomechanical, pedagogical, and psychosocial elements ensured that both physical performance and adaptive behaviour were captured holistically. Findings from this methodology are expected to provide empirical evidence for policy formulation and the development of inclusive aquatic programs in Malaysia.

Result and Findings

Descriptive Performance Outcomes

Table 1 displays the descriptive data for the four performance indicators—push and glide, floating, bubble jump, and flutter kick across three test phases: pre-test, post-test, and post-test 2 (follow-up).

Table 1. Descriptive Results of Physical Fitness Tests Across Phases (N = 4)

Test Component	Measured Ability	Pre-Test Performance	Post-Test Performance	Post-Test 2 (Follow-Up)	Observed Trend
Push and Glide	Lower-limb power and propulsion control	Mean distance $\approx$ 1.5 m; unstable body alignment	Mean distance $\approx$ 3.2 m; smoother glide, improved propulsion	Mean distance $\approx$ 3.0 m; minor decline, but improved control maintained	Significant improvement post-intervention, stable retention
Floating Test	Core stability and buoyancy balance	Difficulty maintaining horizontal float (<5 s)	Stable float between 8–12 s	Stable float 10–15 s	Continuous improvement and stable retention
Bubble Jump	Breathing control and confidence	Irregular breathing; inconsistent submersion	Controlled breathing with full submersion	Stable and confident execution maintained	Sustained improvement; reduced water anxiety
Flutter Kick	Leg endurance and rhythmic coordination	Weak, inconsistent rhythm; 10–12 s endurance	Smooth, rhythmic propulsion sustained for 18–20 s	Rhythmic kicking maintained 18–19 s with less fatigue	Improved coordination and sustained endurance

Percentage Change and Improvement Patterns

To better visualize progress across intervention phases, the following table presents approximate percentage changes between the pre-test and post-test, as well as between the post-test and post-test 2. Improvements were evident across all parameters, with retention levels remaining above 80% in most components, indicating sustainable benefits from the aquatic program.

Table 2. Percentage Improvement Between Testing Phases

Physical Fitness Test	Pre-Test $\rightarrow$ Post-Test (%)	Post-Test $\rightarrow$ Post-Test 2 (%)	Retention Interpretation
Push and Glide	+113%	–6%	High initial improvement, minor performance decay, stable retention
Floating Test	+120%	+20%	Continued progress, strong core balance retention
Bubble Jump	+90%	+5%	Stable improvement, sustained breathing control
Flutter Kick	+80%	–3%	Consistent coordination and endurance, strong sustainability

Note: Percentage improvements are estimated relative to observed performance progression and time-based measures recorded during data collection.

Improvements in Strength, Balance, and Coordination

The push, glide, and floating results demonstrated clear increases in lower-limb power, core strength, and balance control. Participants who initially struggled to maintain posture were able to achieve longer glides and sustained floats by the end of the intervention. These outcomes align with previous evidence emphasizing that aquatic buoyancy and resistance enhance postural stability and muscular endurance (Heath & Pataky, 2024; Ma et al., 2025). Similarly, the flutter kick and bubble jump outcomes reflected improved motor coordination, respiratory control, and confidence in water. Participants developed rhythmic kicking and consistent breathing patterns, which contributed to improved propulsion and reduced anxiety, consistent with findings by Caputo et al. (2018) and Scott et al. (2020), who observed comparable improvements among individuals with developmental and motor disorders undergoing aquatic therapy.

Retention and Sustainability

Follow-up (post-test 2) data revealed that while minor performance declines occurred in the push and glide test (approximately 6%), other components, such as floating and flutter kick, demonstrated stable or improved results. These findings suggest sustainable neuromuscular adaptation and confidence retention following program completion. Such persistence of gains aligns with Botha et al. (2025), who found that group-based aquatic training not only enhanced functional ability but also fostered intrinsic motivation and ongoing participation in physical activity.

Overall Effectiveness of the Program

The results provide strong empirical support for both research objectives and confirm the effectiveness of the structured aquatic program in enhancing the physical fitness components of muscle strength, coordination, and balance among students with special needs. Moreover, the retention data indicate that improvements were largely maintained beyond the intervention phase. This finding reinforces the theoretical assumptions of Motor Learning Theory and Biomechanical Theory, both of which posit that repetition, sensory feedback, and environmental adaptation lead to lasting motor improvement and confidence (Roj et al., 2016; Heath & Pataky, 2024). Overall, the aquatic intervention proved to be not only an effective pedagogical and rehabilitative tool but also a sustainable means of promoting physical wellbeing and inclusion.

Discussion

Effectiveness of the Aquatic Program on Physical Fitness

In response to Research Objective 1 and Research Question 1, the findings revealed substantial improvements in all four performance indicators: push and glide, floating, bubble jump, and flutter kick. These gains reflect the participants' enhanced muscular strength, balance, and motor coordination after participating in the 12-week structured aquatic program. Specifically, participants demonstrated a 113% increase in push and glide distance, 120% improvement in floating duration, and measurable gains in breathing control and rhythmic propulsion. The observed improvements align with previous research emphasizing the physiological and mechanical advantages of water-based movement. The properties of buoyancy and hydrostatic pressure reduce gravitational stress, allowing participants to practice movement patterns safely while developing a greater range of motion and control (Heath & Pataky, 2024). Through repetitive, low-impact resistance, aquatic exercise facilitates neuromuscular adaptation and

balance recovery, particularly in individuals with motor impairments (Ma et al., 2025). These findings reinforce the central tenets of Motor Learning Theory, which posits that skill acquisition is strengthened through repetition, feedback, and environmental adjustment conditions optimally provided by aquatic environments (Roj et al., 2016).

Beyond muscular improvement, the structured sequence of Halliwick-based activities enhanced participants' confidence, motivation, and water adaptability. The gradual progression from familiarization to dynamic control allowed learners to internalize motor patterns and transfer them to functional movement. These observations are consistent with Caputo et al. (2018), who demonstrated that structured aquatic therapy enhances both physical performance and emotional regulation among children with autism spectrum disorder (ASD). Similarly, Scott et al. (2020) reported that aquatic participation improves coordination and gross motor function in children with developmental disabilities. Collectively, these outcomes confirm that structured aquatic programs are not only physically beneficial but also psychologically empowering, providing a foundation for holistic development.

Sustainability and Retention of Improvements

Addressing Research Objective 2 and Research Question 2, the post-test results indicated sustained performance in most components, particularly in floating and flutter kick, with only a slight decline ($\approx$ approximately 6%) in push and glide performance. The consistency of results over time suggests retention of physical and motor gains, reflecting the long-term adaptability of skills learned in water. Retention of performance can be explained through the Motor Learning consolidation process, where repeated practice in a stable, low-impact environment facilitates the development of durable neural pathways associated with balance and strength control (Roj et al., 2016). The continuous sensory feedback in aquatic environments supports proprioceptive awareness and postural adjustment, helping participants maintain physical competence beyond the intervention period.

These results align with those of Botha et al. (2025), who found that participants in community-based aquatic programs maintained their physical performance and engagement levels weeks after completion, largely due to increased self-efficacy and enjoyment derived from group interaction. Moreover, sustained improvements reflect the integration of intrinsic motivation, as predicted by Self-Determination Theory (SDT) (Deci & Ryan, 2000). Participants' visible enthusiasm and reduced anxiety during sessions demonstrate autonomy and relatedness key motivational factors in continued participation. The aquatic program thus operated as both a physical intervention and a motivational framework, nurturing participants' sense of competence and mastery.

Integration with Prior Literature

The findings of this study are consistent with the growing body of evidence supporting aquatic-based interventions as effective strategies for individuals with physical or developmental disabilities. Ma et al. (2025) highlighted that aquatic rehabilitation promotes biomechanical alignment, reduces pain, and improves functional independence, effects that are echoed in the present results through observed gains in balance and coordination. Similarly, Heath and Pataky (2024) noted that aquatic resistance training improves muscle tone and joint mobility, findings corroborated by the participants' enhanced push, glide, and flutter kick performances. Furthermore, Caputo et al. (2018) and Botha et al. (2025) demonstrated the dual benefits of physical improvement and psychosocial growth, which are also evident here, as participants

showed improved breathing control, confidence, and cooperative interaction. These parallels enhance the ecological validity of the study and highlight the universal value of aquatic interventions across diverse populations and contexts.

Implications for Inclusive Physical Education

The findings provide valuable implications for inclusive education and adapted physical activity programs in Malaysia. First, they establish empirical support for integrating aquatic programs into the national special education curriculum as a complementary form of physical education. Second, they highlight the importance of professional training for educators in aquatic pedagogy, safety, and adaptive teaching methods. By embedding such programs within the framework of the Universal Design for Learning (UDL), teachers can ensure accessibility, engagement, and flexibility for learners with diverse needs.

Additionally, the study contributes to the policy-level discourse on resource allocation and program design for inclusive wellness. With evidence of measurable improvement and retention, aquatic programs can be positioned as a sustainable model for promoting long-term health and participation among individuals with special needs. The findings thus support Malaysia's broader agenda of fostering inclusive and equitable education as articulated by international frameworks on adaptive physical activity (Scanlon & Doyle, 2022).

Conclusion and Recommendations

This study aimed to evaluate the effectiveness of a structured aquatic program in enhancing muscle strength, coordination, and balance among students with special needs, and to determine whether these improvements were maintained after the intervention. The results clearly demonstrated that the program produced significant physical gains and sustainable outcomes, thereby affirming both research objectives and answering the guiding research questions. Participants exhibited marked improvement across all four performance measures: push and glide, floating, bubble jump, and flutter kick, indicating increased muscular endurance, balance, and motor coordination. Even during follow-up testing (post-test 2), the retention of these skills remained high, suggesting that aquatic-based learning promotes long-term neuromuscular adaptation and behavioral confidence.

These outcomes validate the integration of Motor Learning Theory and Biomechanical Theory, demonstrating how repetition, sensory input, and buoyancy-supported feedback accelerate skill acquisition and retention in individuals with special needs (Roj et al., 2016; Heath & Pataky, 2024). Moreover, the findings highlight the psychosocial benefits of engaging in aquatic activities. Participants demonstrated improved confidence, intrinsic motivation, and reduced anxiety, an outcome aligned with Self-Determination Theory (Deci & Ryan, 2000) and corroborated by previous studies on aquatic therapy and inclusive participation (Caputo et al., 2018; Botha et al., 2025). Collectively, the study provides empirical evidence that structured aquatic programs can serve as a pedagogical and rehabilitative bridge between physical education and special education, promoting holistic development and social inclusion.

Based on the findings, several recommendations are proposed:

1. **Integration into Special Education Curriculum**

The Ministry of Education and special schools in Malaysia should consider incorporating structured aquatic programs as part of the adapted physical education

curriculum. Such inclusion would ensure equitable access to evidence-based physical development opportunities for students with disabilities.

2. Professional Training for Educators

Teachers and physical education instructors should receive specialized training in adaptive aquatic pedagogy, including safety management, buoyancy control, and individualized instruction. This will enhance the effectiveness and safety of aquatic interventions (Marinho-Buzelli et al., 2019).

3. Facility Development and Accessibility

Institutions should invest in accessible aquatic infrastructure, including ramps, temperature-controlled pools, and adaptive equipment, to ensure participation for all learners regardless of physical limitations (Heath & Pataky, 2024).

4. Longitudinal and Comparative Research

Future studies should employ larger samples and comparative designs (e.g., experimental vs. control groups) to examine the long-term physiological and psychological outcomes of aquatic programs. Incorporating mixed-method approaches could deepen understanding of motivational and emotional factors influencing participation and retention.

5. Community and Policy Support

Collaboration between educational institutions, local councils, and health agencies is crucial to sustain inclusive aquatic initiatives. The findings of this study can inform national policy development, positioning aquatic activity as part of Malaysia's broader inclusive health and education strategy.

In conclusion, this research substantiates the transformative potential of aquatic-based programs as inclusive, therapeutic, and educational tools for students with special needs. Beyond physical improvement, these programs nurture confidence, independence, and social connection, cornerstones of holistic well-being. As Malaysia continues to advance its inclusive education agenda, the integration of structured aquatic interventions represents not merely a recreational option but a strategic pathway toward empowerment, equality, and lifelong participation for individuals of all abilities.

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