

Adaptive Swimming Instruction for Specially Abled Children: Enhancing Aquatic Skill Acquisition Through Special Education Practices

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ABSTRACT:

Adaptive swimming instruction has emerged as an inclusive approach for supporting aquatic learning among children with disabilities. The present research examined how special education practices can enhance aquatic skill acquisition through structured, individualised, and safety-oriented swimming instruction. A secondary-data-based analytical design was used, drawing on open-access datasets and supplementary sources related to adapted swim instruction, aquatic readiness, Halliwick-based intervention, motor competence, and swimming-risk behaviour. The analysis focused on water orientation, confidence, breathing control, floating, gliding, propulsion, coordination, and safety skills as key components of aquatic learning. Findings indicated that adaptive swimming programmes supported measurable improvement in swim-skill progression, particularly when instruction included individualised support, progressive task sequencing, emotional regulation, and disability-sensitive assessment. The evidence also showed that aquatic instruction may contribute to motor coordination, functional participation, water confidence, and safety awareness among children with physical, intellectual, and neurodevelopmental disabilities. Special education practices were central to making swimming instruction accessible through differentiated teaching, structured routines, visual and tactile cues, instructor support, and collaborative planning. Adaptive swimming should therefore be viewed as an educational intervention that promotes aquatic competence, inclusion, and safer participation in water-based environments.

Keywords: Adaptive Swimming Instruction, Children with Disabilities, Aquatic Skill Acquisition, Special Education Practices, Water Safety.

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INTRODUCTION

Reflecting this, aquatic education has become an important part of inclusive child development due to the motor learning, safety awareness, confidence building and participation in a supportive physical environment of swimming. Children with disabilities encounter unique sensory stimuli, the reduced demands for weight bearing and moving through structured/prescribed movements in the aquatic environment can present a learner with a unique learning space to try a skill that may otherwise be challenging on land. Fundamental movement skill development in children is also closely associated with swimming, as children who swim are required to coordinate, balance, propel, control their breathing and orient their bodies, and this has a positive impact on drowning prevention and lifetime safety competence (Sinclair & Roscoe, 2023). Thus, adaptive swimming should not only be considered as recreational training, but as a special education practice which may help the physical, emotional and functional development.

Many factors can limit the opportunities for children with motor impairments to be physically active, including factors related to mobility, balance, fatigue, confidence and environmental access. Aquatic exercise has been suggested as a potential therapeutic method for children with cerebral palsy as it could help to improve walking ability, enjoyments, participation and quality of life in a less restricted environment to move (Nakatani et al., 2025). There also suggests that children with cerebral palsy might have a better muscle strength and physical function with repeated aquatic exercise, particularly if the exercises are structured and delivered progressively (Esmailyan et al., 2023). It is also evident from the studies on therapist-led swimming lessons that with the support of a qualified instructor, supervision and tailored learning, aquatic instruction is possible for children with physical disabilities (Matsuda et al., 2021).

One challenge with adaptive swimming is that the traditional evaluation of swimming ability may

not accurately reflect children's learning experience who have a neuromuscular, neurodevelopmental or intellectual disability. This type of learner can advance in the stages of water orientation, emotional regulation, breath control, floating, and assisted-traversing movement, before the formal demonstration of stroke performance. Therefore, disability-specific assessment tools are required to measure "aquatic readiness" in addition to assessing the speed or technical stroke accuracy, and to measure "aquatic independence," "aquatic participation," and the distance covered by "aquatic functional progress" (Güeita-Rodríguez et al., 2021). In special education settings, progress needs to be judged against individual goals, needs, safety behaviours, and student confidence.

Aquatics teaching is also very relevant for children with autism and intellectual disabilities. Aquatic programmes have been found to promote social interaction and gross motor development in adolescents with ASD and may provide opportunities for communication, imitation, turn-taking and body control through swimming related instruction (Battaglia et al., 2019). These wider health-related benefits have also been reported in children with a disability who participated in aquatic exercise with reported association of physical fitness, immune-related indicators and health outcomes in general (Kim et al., 2018). Aquatic interventions can create opportunities for structured movement for learners with intellectual disabilities which can benefit their physical health, engagement and participation in adapted activity settings (Tsalis & Kyriakidou, 2023). Systematic evidence also exists of the value of aquatic exercise for developmental, physical and participation outcomes for people with intellectual disabilities (Salse-Batán et al., 2023).

From water safety considerations, the aspects of adaptive swimming become more critical. The training of basic swimming and water-safety skills is known to be a valuable part of drowning prevention for children, especially if it involves entry and exit, floating, breathing control,

recovery and safe behaviour around water (Criel et al., 2025). Drowning prevention is also a worldwide child-health issue; and prevention for children under 20 years should involve educational, behavioural, environmental and skills-based strategies (Ashraf et al., 2024). These concerns are increased for children with disabilities as swimming instruction in mainstream programs may be limited due to barriers for children with disabilities.

The pedagogical basis of making swimming instruction accessible and effective is special education practices. Teacher attitudes and confidence, training and willingness to adapt to diverse learners are important factors in inclusive physical education (Tarantino et al., 2025). The findings from teachers' perspectives also reveal that communication, planning, flexible grouping, modifying aspects of the environment, and providing individualized support are all essential for supporting participation for students with disabilities (Bertills & Björk, 2024). The coordinated provision of services for learners is also dependent on the cooperation of adapted physical educators, special educators, therapists, administrators, and families to help address service barriers (McNamara et al., 2019). Some challenges remain, however, for inclusive physical education, including teacher preparedness, student participation, peer acceptance and institutional support (Rekaa et al., 2019).

Although there has been an increase in evidence of aquatic exercise and adapted physical education, there has been little to no research that has directly incorporated adapted swimming instruction with special education practices and directly measured aquatic skill acquisition. Previous research tends to examine one of the areas of aquatic therapy, motor outcomes, water safety, or inclusive physical education individually, with fewer studies demonstrating how these areas could be integrated into a model of instruction with children with disabilities. To fill this gap, the present article discusses the adaptive swimming instruction as a special education-based strategy to improve children with disabilities' acquisition of swimming skills,

water confidence, motor participation, and safety-oriented learning in a swimming setting. The major objectives of this study are:

- 1.To evaluate the effectiveness of adaptive swimming instruction in improving aquatic skill acquisition among children with disabilities.
- 2.To examine the role of special education practices in supporting water confidence, safety skills, and swimming readiness.
- 3.To assess how structured aquatic activities contribute to motor coordination and functional participation.
- 4.To identify the relevance of disability-sensitive assessment in measuring aquatic learning progress.

1. LITERATURE REVIEW

Instructing children with disabilities in the water is being increasingly looked at as a formal education and/or treatment strategy rather than just a recreational activity. Current research demonstrates that water-based programs can be utilized to facilitate motor coordination, balance, emotional control, communication, confidence and safety-related behaviors with content modified to the developmental profile of the learner. Aquatic interventions have garnered specific attention for children with ASD as they offer predictable sensory inputs, reduced gravitational load, opportunities for repetitive movements, and engagement in social interaction. Children with ASD can benefit from swimming-based programmes that use structured and individualised approaches, as this type of intervention is relevant to motor and social functioning outcomes, according to a systematic review of aquatic interventions for children with ASD (Van T Hooft et al., 2024).

Research on aquatic exercise training in children with ASD also indicates that the programme design is of significant importance. Technical aquatic training might enhance gross motor coordination and swimming related control, and game training might promote participation, expression and interaction with peers. This distinction is crucial when it comes to adaptive swimming teaching since children with

disabilities might not react in an even manner to set skill drills and fun learning tasks. Thus, a balanced programme should consist of a combination of skill teaching and interesting 'water' activities that help to hold the attention and lower the level of anxiety. Aquatic training methods for children with ASD have been compared in the literature, with evidence for the benefits of structured movement practice for gross motor skills, stereotyped movement and emotional regulation (Marzouki et al., 2022). Parent and teacher experiences also indicate that communication, patience of the instructor, sensory awareness, planning for safety, and trust between families and professionals are essential ingredients to successful swimming instruction (Carter & Koch, 2023).

Family centred evidence emphasises that swimming benefits are not only physical in nature but also include independence, security and social participation. Parents have expressed concerns with drowning risk, lack of trained instructors, behavioural issues and individualized teaching in regards to children with ASD. The results suggest that adaptive swimming instruction should be tailored to the real-life barriers of swimming and learning. However, qualitative work with families has revealed that opportunities for confidence and enjoyment in the aquatic environment can be created, provided that lessons are tailored to the needs and fears of the individual child (Mische Lawson et al., 2019). Additionally, pilot evidence indicates that swimming programmes have the potential to impact children's behaviour and perceptions of health within the family, therefore introducing the concept of the relevance of swimming to the educational and wellbeing outcomes of children (Johnson et al., 2021). The use of task analysis, individualised goals, sensory supports, and safety-focused instruction, are also key components of occupational therapy-based aquatic work to enhance swim safety and basic aquatic skills for autistic children (Kemp et al., 2023).

Ensuring water safety has been a consistent topic in the autism and other disability children's water literature. Wandering, attraction to water, limited danger awareness and lack of swimming lessons

have been cited as major risks by parents. The concerns demonstrate the importance of entry/exit skills, floating, recovery, breath control, safe behaviour and emergency response in addition to formal stroke development in adaptive swimming. New research in the parent perspective has affirmed the importance of having an instructor be prepared, disability-informed water safety education programmes be available and accessible, and parents be included in the educational process (Cosart et al., 2025). Therapeutic swimming research also suggests that consistent routines and progressive challenges can contribute to attention, learning, activity level, wellbeing and social functioning through therapeutic swimming (Alecú & Onea, 2025).

A number of intervention models have helped to shape adaptive aquatic instruction. Multisystem aquatic therapy for children with ASD focused on emotional adaptation, swimming adaptation and social integration, thereby aligning very closely with the special education principle of treating the whole child or learner, rather than just their motor performance (Caputo et al., 2018). As the same, the study of "Water as a mediator of communication" indicated that aquatic activities can be used as a communication medium, develop the autistic behaviour and acquire new aquatics skills, and social skills training (Zanobini & Solari, 2019). Other research indicates that aquatic training might also help maintain static and dynamic balance via buoyancy, resistance, and movement challenges (Ansari et al., 2021). Further to this, review evidence on neurodevelopmental disorders confirms the role of aquatic therapy in motor skills, social skills, and executive functioning, which are all important skills within the context of special education (Shariat et al., 2024).

The literature does not only include children with autism, but also children with cerebral palsy, children with severe motor impairments and children with other developmental disabilities. Aquatic exercise has been examined for its ability to aid in body function, activity, and participation of children and adolescents with cerebral palsy, recognizing that physical activity in water can

have more functional benefits than swimming ability (Rodrigues Filho et al., 2023). Adapted aquatics for children with severe motor impairments further highlights the necessity for effective lesson planning, flotation support, safety, communication and inclusive participation within a lesson (Conatser et al., 2018). Children with severe disabilities also typically need coordinated support from physical educators, special educators, therapists, aides and families, which requires collaboration as well. In adapted physical education, using a collaborative approach has been demonstrated to be effective in engaging students with severe disabilities in which the goals of instruction, environmental supports, and professional responsibilities are aligned (Grenier et al., 2020). Looking at the literature, it is generally accepted that adaptive swimming instruction is a disability-inclusive, interdisciplinary and educationally significant activity to enhance acquisition of aquatic skills, safety and participation.

2. METHODOLOGY

2.1 Research Design

This study was conducted as a secondary data based analytical study to investigate the correlation between Adaptive swimming instruction for children with disabilities and aquatic skill acquisition. Five open access datasets or supplementary datasets published from 2025 until 2026 were taken into account and applied as per their methodological relevance. The most important evidence source for measuring the effectiveness of the intervention was the 5-day adapted swim instruction dataset and the main aquatic skill assessment framework was the AIM-2 dataset. The datasets used as supporting sources were the dataset for intervention structure (Chacham-Guber et al., 2025), motor-skill development (Carson et al., 2025), and water-safety context (Zhao et al., 2026; Liu et al., 2026; Zhang et al., 2025). The analysis was not a pooled analysis of participants because data were from different study populations, designs, and outcome measures.

2.2 Data Sources and Selection Criteria

The datasets were chosen due to the fact that they

involved at least one of the key components of the article title: adaptive swimming, children with disabilities, aquatic skill acquisition, special education practices, motor development or water safety. The Carson et al. dataset comprised children with disabilities ages 3–18 and the change in swim skill from Day 1 to Day 5. The young swimmers in the AIM-2 were physically disabled and their aquatic readiness was evaluated. Halliwick source offered a 36-session, aquatic exercise program for children with ASD. The DCD supplementary dataset was used to help analyse motor-competence assessment, with the Mendeley dataset for the swimming-risk behaviours analysis being expanded.

2.3 Participants and Dataset Characteristics

The datasets provided were not merged on an individual basis as the different sets of participants were not the same. This adapted swim instruction dataset contained 164 children with disabilities (including autism, Down syndrome, and other disabilities) who were given swim instruction for five days. A total of 108 young people with physical disabilities took part in the AIM-2 data collection, as a total of 4,968 aquatic skill scores were created. A total of 1,666 student records and 100 variables were part of the Student Swimming Risk Behavior dataset. The Halliwick supplementary file outlined a 36-session intervention program for children with autism spectrum disorder (ASD) which has a structure. Pre-post intervention support was provided for children at risk for developmental coordination disorder in the DCD supplementary file.

2.4 Intervention and Assessment Framework

The 5-day adapted swim instruction program was aligned to the Halliwick instructional sequence and to the aquatic skill domains of the AIM-2 framework to create an adaptive swimming instruction framework. The intervention components were water orientation, emotional regulation, breathing control, floating, gliding, kicking, arm movement, coordinated swimming and water-safety skills. Aquatic skill acquisition was organized on the basis of three domains of the AIM-2: adaptation, basic skills and advanced

skills. The Halliwick program was employed to add special education relevance to the instructional model as it incorporated structured progression, repetition, instructor support, parent feedback and aquatic adaptation.

2.5 Data Analysis Procedure

The analysis was carried out in a structured way in a comparative synthesis of the numerical findings with respect to the various datasets. Descriptive data was collected for swim-skill outcomes, assessment domains, intervention duration, disability category, sex, and age and sample size. The Carson et al. dataset was used to report pre-post swimming skill improvement. Aquatic assessment structure, reliability and differences in disability-level were reported using the AIM-2 dataset. Because of its non-disability specific nature, it was decided to only use the Mendeley dataset for contextual description of safety-behaviours. Claims of direct comparative effectiveness across all disability groups were not made using the DCD or Halliwick data sets, but rather as a basis for designing interventions for

them.

3. RESULTS

3.1 Dataset Coverage and Relevance to Adaptive Swimming Instruction

There was a difference in direct relevance of the five datasets to the research title. The dataset by Carson et al. was the most directly relevant since it focused on adapted swim instruction of 164 children with disabilities. The data set of the AIM-2 was exceptionally supportive for aquatic skill measurement and included 108 aquatic skills of young swimmers with physical disabilities and 4,968 skill scores. A detailed 36-session aquatic intervention structure was provided by the Halliwick dataset. The DCD additional data set corroborated the association between swimming and motor competence, and the Student Swimming Risk Behavior data set only provided contextual water-safety data from 1,666 students. The datasets were, therefore, used complementary, not in exchange one for another.

Table 1. Dataset Role and Analytical Relevance to the Present Study

Dataset	Sample / content	Main use in this study	Relevance level
Carson et al. (2025)	164 children with disabilities	Main intervention effectiveness evidence	Very high
Chacham-Guber et al. (2025)	108 swimmers; 4,968 scores	Aquatic skill assessment framework	Very high
Liu et al. (2026)	36-session Halliwick program	Intervention design support	High
Zhao et al. (2026)	Pre-post DCD supplement	Motor competence support	Moderate
Zhang et al. (2025)	1,666 student records	Water-safety context only	Low-moderate

3.2 Participant Distribution in the Main Adapted Swimming Dataset

The primary adapted swimming dataset included 164 children with disabilities aged 3–18 years. The mean age was 9.14 ± 3.53 years. Male participants formed the larger group, with 113 males and 51 females. Autism was the largest diagnostic category, including 72 participants,

followed by Down syndrome with 57 participants and other disabilities with 35 participants. This distribution confirmed that the main dataset was suitable for examining adaptive swimming instruction across more than one disability group, although autism and Down syndrome were more strongly represented than other disability categories (Carson et al., 2025).

Table 2. Participant Profile in the Main Adapted Swimming Dataset

Variable	Numerical value
Total participants	164
Mean age	9.14 ± 3.53 years
Male participants	113
Female participants	51
Autism	72
Down syndrome	57
Other disabilities	35

3.3 Swim Skill Improvement after Adapted Instruction

The measured benefits of the 5 day adapted swimming program were improvements in aquatic skill level. Over half of the participants were not swimmers at baseline (87). By Day 5, 101 participants had progressed by one swim skill

level and 3 participants progressed by two swim skill levels. There were 60 who remained unchanged and none gained 3 levels. The median "swim" skill level was 1.00 on Day 1 and 2.00 on Day 5. This improvement was significant ($z = -10.06, p < .001$), and had a large effect size ($r = 0.58$).

Table 3. Swim Skill Change from Day 1 to Day 5

Level of improvement	Number of participants	Percentage
No change	60	36.6%
Improved 1 level	101	61.6%
Improved 2 levels	3	1.8%
Improved 3 levels	0	0.0%
Total	164	100%

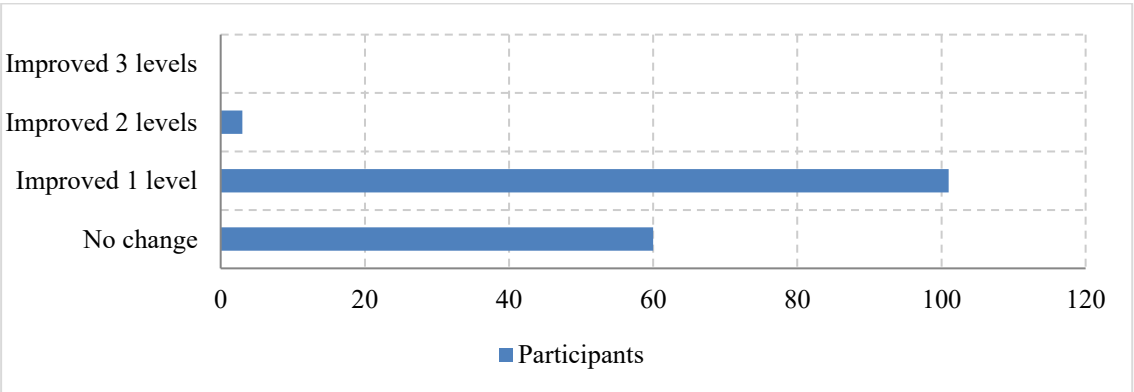


Figure 1. Swim Skill Improvement after 5-Day Adapted Instruction

3.4 Aquatic Skill Domains from the AIM-2 Dataset

The AIM-2 dataset supported the assessment of aquatic skill acquisition through three domains: adaptation, basic skills, and advanced skills. The

original 23-item pool was reduced to 13 retained items through exploratory factor analysis. The three-factor structure explained 64% of the variance. Reliability was strong, with Cronbach’s alpha values of 0.876 for adaptation, 0.879 for basic skills, and 0.823 for advanced skills. The

total AIM-2 scale reliability was 0.890. These values showed that aquatic skill acquisition could be assessed systematically among young swimmers with physical disabilities (Chacham-Guber et al., 2025).

Table 4. AIM-2 Aquatic Skill Domains

AIM-2 domain	Number of retained items	Cronbach’s alpha	Mean score
Adaptation	6	0.876	3.85
Basic skills	4	0.879	1.52
Advanced skills	3	0.823	1.89
Total AIM-2 scale	13	0.890	—

3.5 Supporting Findings from Motor, Halliwick, and Safety Datasets

The supporting datasets strengthened the interpretation of adaptive swimming as a special education practice. The Halliwick dataset presented a 36-session aquatic exercise program, beginning with psychological adaptation and progressing through breathing, floating, gliding, kicking, arm movements, and coordination. The

DCD supplementary dataset reported an a priori sample-size requirement of 13 participants for paired testing, based on $d_z = 0.85$, $\alpha = 0.05$, and power = 0.80. The Student Swimming Risk Behavior dataset included 1,666 records, with a mean age of 14.08 years and 100 variables, but it was used only for water-safety context because it was not disability-specific (Zhao et al., 2026; Liu et al., 2026; Zhang et al., 2025).

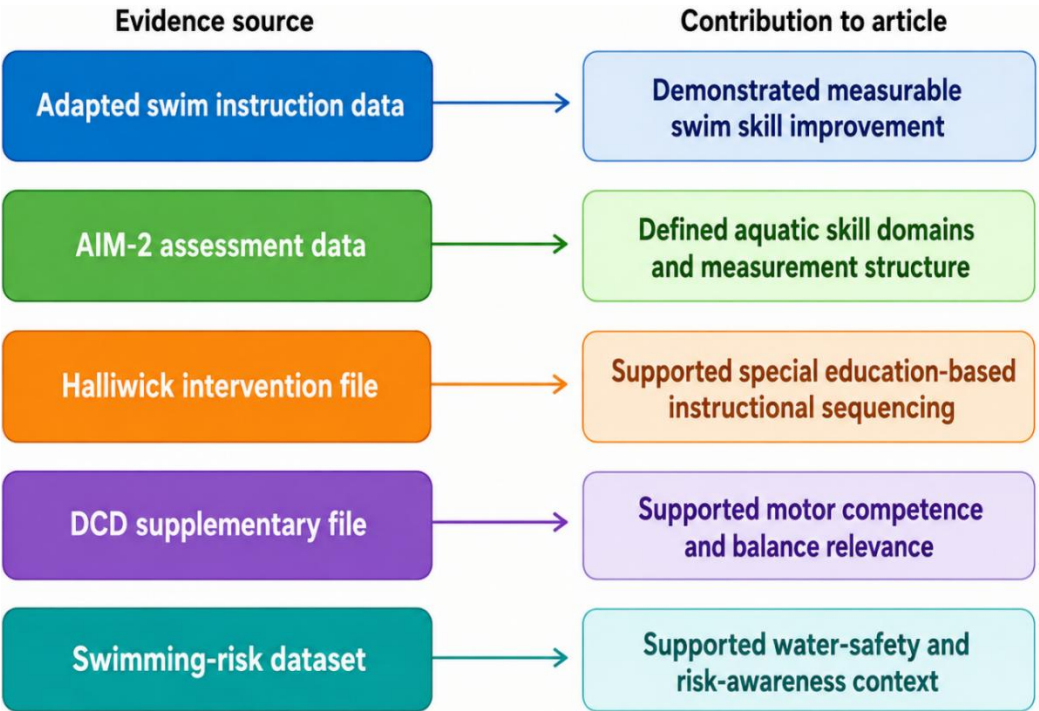


Figure 2. Integrated Adaptive Swimming Evidence Model

4. DISCUSSION

The findings from the integrated evidence suggested that adaptive swimming instruction was a helpful special education-based strategy for facilitating acquisition of aquatic skills with children with disabilities. The improvement pattern underlined the positive effects of the structured aquatic exposures, individualized supports, repetitions, and safety-based instruction on many learners' swimming-skill improvement in moving from lower to higher levels. This growth for the adapted swimming data from Day 1 to Day 5 indicated that benefits could be seen from a relatively brief intervention after changing the way instruction was provided to address the learners' needs. The second finding from the AIM-2 evidence was the learning process of acquiring aquatic skills was not a simple process, but rather a series of stages that included adaptation, basic, and advanced skills. Thus, the outcomes agreed with the disability-inclusive approach to assessing swimming skills in children with disability, rather than the swimming benchmarks. The Halliwick-based intervention structure also allowed for the understanding of the importance of progression from emotional regulation and water orientation to floating, propulsion and coordinated movement for successful learning.

Results were similar to previous studies which demonstrated that swimming skills can be enhanced in a short amount of time with adapted learn-to-swim instruction in children with autism spectrum disorder (ASD) (Munn et al., 2021). Additionally, individualized aquatic instruction was observed to be comparable to randomized evidence of structured water-competency programs to boost aquatic participation and functional water skills in children with autism (Kemp et al., 2024). The evidence validated the social and behavioural relevance of aquatic intervention, which could be beneficial in improving social competence and outcomes related to quality of life, aside from physical performance (Güeita-Rodríguez et al., 2019). Previous research has also confirmed that the Halliwick method is associated with an improvement in aquatic skills via mental

adjustment and rotation control, balance and independent movement in water (Vodakova et al., 2022) which was also applied in the present framework. Safety related interpretation was included, which was congruent with the behavioural water-safety research which highlights structured teaching strategies as essential to teaching the water safety concepts to autistic learners (Martin & Dillenburger, 2019). The use of multiple disability-related evidence sources also was consistent with scoping review results which showed that aquatic therapy was implemented in children and adolescents with a variety of different disabilities (Ogonowska-Slodownik et al., 2024). Further, hydrotherapy evidence also supported the motor-skill interpretation with improvements in athletic and functional abilities, as seen in CP whereby aquatic activities were linked to improvements (Tao et al., 2025). Lastly, the practical focus on how instructors supported the swimming participation of children with disabilities, the accessibility of these environments, and inclusive swimming, was reflective of professional views on children with disabilities and swimming participation (Graham et al., 2025).

It is important to note that the findings have implications for special education, adapted physical education, the rehabilitation of individuals, and the programming of inclusive schools. Adaptive swimming, in addition to being a recreational activity, should be considered as a formal educational program that can help enhance confidence, safety, motor learning, socialization and independence. The development of the aquatic skills in the model of teaching may be done in phases, starting with water orientation and emotional readiness, followed by floating, breathing control, propulsion, coordination and safety skills, and can be used by special educators and aquatic instructors. Results indicate also that the assessment instruments should be based on various phases of the aquatic learning process, not merely on final swimming skills. To make it applicable to practice, teachers, therapists, and swimming teachers should work together to develop individual aquatic objectives, use visual

and tactile cues, modify equipment, offer 1:1 assistance (if needed), and track the outcomes via the structured aquatic skill domains.

It should be recognised that there are a number of restrictions. The evidence sources that were included were not from a single data source such that it was not possible to combine participant-level data from all sources. Short-term pre-post outcomes were used for the primary adapted swimming evidence leaving a lack of understanding about long-term retention, generalization and continued aquatic participation. Results of some sources were specific to a particular disability group (e.g., autism, physical disability or developmental coordination difficulty) which made it hard to generalise equally to all groups of disabilities. Unfortunately, the swimming-risk dataset was not specific enough to be used for a disability-specific swimming-risk context, and so it was only available for safety context. Moreover, the length of intervention, measures used, outcome definitions and participant characteristics were different across the various sources. Future research should design and implement a prospective study with a larger sample size, aquatic-skills assessment standardized across all samples, disability-specific sub-group analysis and follow up testing, and a direct comparison of adaptive and conventional swimming instruction.

6. CONCLUSION

Through special education practices, adaptive swimming instruction provides a relevant means

for enhancing the skill acquisition of children with disabilities. The results suggest the importance of repeated exposure to water, individualized teaching, structured progression, emotional readiness, and disability-sensitive assessment for swimming development. Children can learn more effectively in water when they are introduced and supported gradually, with water orientation, breathing control, floating, gliding, propulsion, coordination and safe entry and exit skills. The stages support the learner in building confidence prior to swimming independently.

The evidence further shows the need for collaboration between special educators, adapted physical education teachers, therapists, swimming teachers, or between the school and the family. This can enhance the safety of aquatic instruction, create more inclusive learning environments, and be more responsive to a variety of learning needs. Adaptive swimming should thus be regarded as a learning activity, and not just a leisure pursuit. It can help with water-safety competence, social engagement, functional participation and motor coordination.

There is a need for future programmes to include standardised aquatic skill measurement, longer follow-up times and disability specific instructional strategies to assess sustained progress. Further larger empirical studies are warranted to compare the models of adaptive swimming and to find the most effective models for children with different physical, intellectual and neurodevelopmental disabilities.

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