

Adapted swimming, aquatic skill development and emotional regulation in children with Autism Spectrum Disorder (ASD) and Intellectual Disability (ID)

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Abstract

Emotional regulation is a fundamental psychological process that enables individuals to manage and adapt their emotional responses in ways that support well-being and social functioning. Children with Autism Spectrum Disorder (ASD) and Intellectual Disability (ID) frequently experience difficulties in emotional regulation, which may contribute to emotional, behavioral, and social challenges. Despite growing evidence supporting the benefits of adapted swimming, limited research has simultaneously examined improvements in aquatic skills and emotional regulation in these populations. This study investigated the efficacy of an adapted swimming program with visual prompts in improving both aquatic skills and emotional regulation in children with ASD and ID. Thirty children (20 with ASD and 10 with ID) were randomly assigned to an experimental group (EG; n = 17) or control group (CG; n = 13). The EG participated in a 14-week adapted swimming program with visual prompts. Participants were assessed before and after the intervention to examine changes in aquatic skills and emotional regulation outcomes, including within-group improvements and between-group differences. Significant pre- to post-intervention improvements were observed exclusively in the EG across measures of aquatic skills and emotional regulation. Furthermore, post-intervention comparisons revealed significantly better outcomes for the EG than the CG, supporting the effectiveness of an adapted swimming program with visual prompts for children with ASD and ID. Significant positive associations were observed between aquatic skills measures (WOTA-1 and A-SEAS) and between A-SEAS (Emotional Adjustment) and ERC scores. Overall, an adapted swimming intervention with structured visual supports appears to be an effective approach for enhancing both functional aquatic abilities and emotional regulation, providing new evidence for the role of aquatic environments in promoting holistic developmental outcomes.

Keywords: autism spectrum disorders, intellectual disability, aquatic skills, emotional regulation, adapted swimming.

Introduction

Autism spectrum disorder (ASD) and intellectual disability (ID) are neurodevelopmental conditions that emerge during the developmental period and typically become evident early in life (APA, 2013). Children and adolescents with ASD and ID often experience challenges in motor development, socialization, and emotional adjustment (Chen et al., 2022; Girgis et al., 2024), which can adversely affect academic achievement and social integration, ultimately reducing their quality of life (Carcelén-Fraile et al., 2025). In addition, difficulties with emotional regulation, alongside mood-related problems such as anxiety and depression, as well as behavioral challenges including aggression and impulsivity, can significantly hinder successful adaptation across social and educational settings (Defayette et al., 2021).

Current academic knowledge emphasizes that these challenges are not independent but interact dynamically, since motor competence is directly associated with social adaptability in children with ASD (Chen et al., 2022), while executive functioning mediates the link between gross motor skills and emotional understanding (Li et al., 2022). Consequently, interventions for children with ASD and ID should extend to include not only the isolated acquisition of motor and functional skills, but also the comprehensive development of emotional and adaptive skills that support participation and independence in everyday life (Carcelén-Fraile et al., 2025).

Emotional regulation (ER) is a complex and multifaceted process that involves both the generation of emotional responses and the ability to modulate their intensity, duration and expression in ways that support adaptive functioning and socially appropriate behavior (Gross, 2015; Sheppes et al., 2015). As a fundamental component of psychological well-being, difficulties in ER have been consistently associated with a range of mental health challenges, including anxiety, depression, and externalizing behaviors (Beck et al., 2020; Cai et al., 2018; Cibralic et al., 2019).

Difficulties in ER are particularly evident among children and adolescents with intellectual disabilities, who often demonstrate delays in the development of self-regulatory skills, a limited capacity to understand and manage emotional experiences effectively and a reduced likelihood of employing adaptive coping strategies (Te

Brinke et al., 2021). Similarly, children and adolescents with ASD often experience difficulties in recognizing, interpreting, and regulating their emotions. These difficulties are closely linked to deficits in social communication and interaction and may manifest as maladaptive or impulsive behaviors, including tantrums and aggression (Mazefsky, 2015). Furthermore, they tend to rely on less adaptive ER strategies, thereby contributing to emotional and behavioral difficulties (Mazefsky, 2015). Given the prevalence and impact of ER difficulties among individuals with these neurodevelopmental disorders, growing research attention has focused on the potential role of physical activity interventions in promoting emotional and psychological well-being.

Thus, ER represents an important target for intervention in children with ASD and ID, not only because difficulties in ER may be associated with emotional and behavioral problems (Cai et al., 2018), but also because improved ER may facilitate participation, learning and interaction with others (Mazefsky, 2015). Given that traditional interventions that rely heavily on verbal and cognitive skills can be challenging for children with communication delays, adapted non-verbal approaches using visual prompts that can modulate expression of emotions are critically needed (Sheppes et al., 2015). In practice, intervention approaches that can address both emotional functioning and motor development may therefore be particularly valuable for these children.

Physical activity has been associated with improvements in cognitive, emotional, and behavioral functioning through neurobiological mechanisms involved in ER, mood, and attention (Voss et al., 2013; Miranda et al., 2019). Accordingly, structured physical activity interventions have demonstrated positive effects on ER, adaptive behavior and social functioning among children with neurodevelopmental disorders (Eisenberg et al., 2010; Greco & De Ronzi, 2020; Ryuh et al., 2019; Shaw et al., 2016). Among the various forms of physical activity, aquatic interventions have gained increasing attention as a particularly suitable approach for children with neurodevelopmental disorders due to the multisensory properties of the aquatic environment (Ansari et al., 2021; Lee & Porretta, 2013), the supportive effects of buoyancy and hydrostatic pressure on movement and sensory processing (Pan, 2010; Vonder Hulls et al., 2006), reduced physical demands and opportunities for social interaction and emotional engagement (Pan, 2011). Moreover, aquatic settings may promote relaxation, enjoyment, and engagement (Alaniz et al., 2017; Caputo et al., 2018; Tsolaki et al., 2023), which can facilitate participation and emotional expression. In children with ASD, aquatic interventions have also been associated with improvements in communication, adaptive behavior, and social responsiveness (Battaglia et al., 2019; Caputo et al., 2018).

Despite these encouraging findings, relatively few studies have examined the effects of aquatic interventions on ER and social behavior in children with ASD (Caputo et al., 2018; Marzouki et al., 2022; Pan, 2010). Research involving children with ID is even more limited, with most studies focusing primarily on aquatic skill development rather than psychosocial or emotional outcomes (Casey & Emes, 2011; Hartlage et al., 2021; Top, 2015). As a result, evidence regarding the potential contribution of aquatic interventions to ER and social functioning in children with ID remains scarce.

Addressing this gap is critical. Within this context, there is a clear need to investigate well-structured and appropriately adapted practices of aquatic activity that can accommodate individual developmental and emotional needs while maintaining active and meaningful participation. While existing literature explores adapted swimming for ASD and ID youth, empirical research combining both populations within larger sample sizes remains rare. A notable exception is the study by Tsolaki et al. (2023), which successfully bridged this gap by investigating the impact of a community-based, public 'Sports for All' therapeutic swimming program on the aquatic readiness and emotional satisfaction of children diagnosed with both intellectual disabilities (ID) and autism spectrum disorders (ASD). Although Tsolaki et al. (2023) provided evidence that participation in therapeutic swimming is associated with positive aquatic and affective outcomes, emotional satisfaction and emotional regulation are not identical constructs. Emotional satisfaction reflects positive affective responses to participation whereas ER refers to the broader ability to manage and adapt emotional responses. Thus, further research is needed to determine whether adapted swimming can contribute to measurable improvements in ER rather than only producing enjoyment or satisfaction during aquatic participation.

Kokaridas, Tsolaki and Krommidas (2025) extended their research efforts by developing the Adapted Swimming and Emotional Adjustment Scale (A-SEAS), an observational, 14-item instrument specifically designed for children aged 6 and older with ID and ASD. This newly established tool addressed a major limitation in existing evaluation instruments, which predominantly target physical disabilities like cerebral palsy. Crucially, the A-SEAS introduced a novel approach by evaluating emotional adjustment alongside each swimming task, reflecting the growing recognition that emotional adjustment, satisfaction, and joy are just as vital as motor skill acquisition, particularly for children with ASD and ID who frequently face motor development barriers (Fernandes et al., 2024; Odeh et al., 2022). This dual focus is theoretically grounded in developmental psychology, which demonstrates that executive function skills serve as the key mediator linking children's gross motor skills directly to their emotional understanding (Li et al., 2022). Thus, A-SEAS represents an important development in the current level of knowledge since it permits aquatic performance and emotional adjustment considered within the same assessment framework, allowing researchers to determine whether improvements in aquatic competence are accompanied by positive changes in children's emotional responses during participation.

In this regard, this research trajectory was further extended through the study of Tsolaki et al. (2026), which examined the effects of an adapted swimming program incorporating visual prompts on executive functions and frontal lobe activation in children with ASD and ID. The findings demonstrated that the use of structured visual supports in place of complex verbal instructions enhanced executive control, visual processing, and motor efficiency. Furthermore, the study contributed to the literature by combining exergame performance and functional near-infrared spectroscopy, providing complementary neurophysiological and cognitive evidence within aquatic environments (Tsolaki et al., 2026). The use of visual prompts is particularly relevant in this context, as children with ASD and ID benefit from the clear, predictable, and sequential information that visual supports provide when learning new motor tasks (Kellems et al., 2020; Hume et al., 2021; Cruz-Torres et al., 2020; Stierle et al., 2023). In aquatic settings with tasks often involving several sequential motor actions, such structured visual guidance offers an important practical means of adapting instruction to individual needs.

While previous research has primarily focused on the contribution of adapted swimming to aquatic skill development, less attention has been given to the relationship between skill acquisition in water and emotional regulation among children with ASD and ID. This leaves a critical gap in the literature, as motor challenges and emotional dysregulation are deeply interconnected in this population, yet they are rarely addressed within a unified therapeutic context.

Adapted aquatic environments can provide a unique context in which motor learning and emotional development evolve concurrently through structured participation and positive engagement. Building on this perspective, the present study conceptualizes adapted swimming not only as a means of developing aquatic competence but also as an opportunity to foster emotional growth and behavioral adaptation. Specifically, the study investigates the effects of an adapted swimming program supported by visual prompts on aquatic competence and emotional regulation. Using the Adapted Swimming and Emotional Adjustment Scale (A-SEAS), it further explores the extent to which improvements in swimming performance are associated with positive emotional adaptation during participation in aquatic activities.

In doing so, the study contributes to the limited body of research examining aquatic skill acquisition and emotional regulation simultaneously within the same intervention framework. To address this issue, the study employed a structured adapted swimming intervention incorporating visual picture cards and brief video prompts, progressive task sequencing, individualized adaptations and opportunities for cooperation and independence. The intervention was implemented over 14 weeks, with two 60-minute sessions per week, allowing children with ASD and ID to progress through aquatic activities according to their own developmental level. Aquatic competence was assessed using the WOTA-1 and the aquatic skills component of A-SEAS, whereas emotional functioning was examined using the Emotion Regulation Checklist (ERC) and the emotional adjustment component of A-SEAS. Pre- and post-intervention measurements were compared between an experimental and a control group, while correlation analyses were used to examine relationships between aquatic skills and emotional outcomes.

Thus, the purpose of this study was to investigate the efficacy of an adapted swimming program with visual prompts in improving both aquatic skills and emotional regulation (ER) in children with Autism Spectrum Disorder (ASD) and Intellectual Disability (ID). Establishing whether these outcomes improve concurrently, this study seeks to provide an evidence-based, dual-purpose strategy to maximize session efficiency while allowing adapted physical educators and coaches to support real-time emotional and behavioral regulation of these children within aquatic settings.

Materials and Methods

Participants

Thirty children with developmental diagnoses of intellectual disability (ID) and autism spectrum disorder (ASD) participated in this study, all formally assessed by the Centers for Interdisciplinary Assessment, Counseling, and Support; 20 were diagnosed with ASD and 10 with ID.

The participants ranged in age from 6 to 15 years and included 21 boys and 9 girls. Specifically, the ID group comprised six boys and four girls, while the ASD group consisted of fifteen boys and five girls.

Participants were randomly assigned to an experimental group (EG; $n = 17$), which included 11 children with ASD and 6 with ID and a control group (CG; $n = 13$), consisting of 9 children with ASD and 4 with ID. Recruitment was conducted following official permission from the Department of Primary Education to contact parents of children attending integration classes, inclusive education settings, or special education schools.

The principal researcher informed the parents about the combined adapted swimming and visual prompts program. Prior to participation, legal parents or guardians reviewed the informed consent form—either independently or via dictation—and subsequently signed it. The study protocol and procedures were approved by the Bioethics Committee of the University of Thessaly (protocol number 2366-3/4-2024).

Instruments

The following instruments were used to assess the participants' aquatic and behavioral profiles:

- *Emotion Regulation Checklist (ERC)*: A 24-item parent-report questionnaire (Shields & Cicchetti, 1997) with well-established validity and reliability, evaluating children's emotional management. It uses a 4-

point frequency scale (1 = never to 4 = always) and provides two subscales, namely, Emotion Regulation (adaptive processes, empathy) and Lability/Negativity (mood lability, dysregulation).

- *Water Orientation Test Alyn 1 (WOTA 1)*: A 13-item assessment tool (Tirosh et al., 2008) scored on a 4-point scale (1 to 4) designed for individuals aged 3 and older with limited functional and cognitive skills. A score of 4 indicates successful activity execution.
- *Adapted Swimming and Emotional Adjustment Scale (A-SEAS)*: An instrument (Kokaridas et al., 2025) designed for children aged 6 and older with ASD and ID, featuring a dual rating system that includes a 5-point scale (0 to 4) for swimming performance development and a 4-point scale (0 to 3) to capture emotional adjustment during each activity.

Procedure

EG participants were randomly divided into teams of five or six children. Two assistants provided support when needed to guarantee safety and ensure smooth activity transitions. All sessions were conducted by the primary researcher and they were video-recorded with prior parental consent, maximizing the reliability and accuracy of the assessments throughout the intervention.

The intervention program was developed as an adapted aquatic intervention for children with ASD and ID, aiming to enhance both functional and emotional outcomes. It was based on opportunities for self-exploration within the aquatic environment and the use of visual prompts to facilitate understanding, independence, and active participation in aquatic activities. The program was delivered through systematically structured sessions in which visual supports, progressive task sequencing, and individualized adaptations were integrated throughout all activities. The intervention was implemented over a 14-week period and consisted of two 60-minute sessions per week, conducted in the small pool of the municipal swimming facilities of Trikala.

Visual supports were systematically integrated throughout the intervention and consisted of picture cards and brief video prompts presented on a tablet. These visual prompts were used to enhance understanding of instructions, support task sequencing, and increase participants' engagement, independence, and individual skill development during the sessions. Each session emphasized individual skill development while simultaneously promoting cooperation, communication, and social interaction through structured group activities in the aquatic environment.

The use of visual prompts was informed by evidence indicating that individuals with ASD and ID benefit from structured, visually supported instruction that reduces cognitive load and facilitates step-by-step task completion (Kellems et al., 2020; Hume et al., 2021). Video-based approaches, together with static visual supports such as picture cards, have been shown to enhance skill acquisition and independence by providing clear demonstrations and structured sequential guidance (Cruz-Torres et al., 2020; Stierle et al., 2023). Accordingly, the intervention integrated both video and pictorial supports to facilitate learning, support task sequencing and promote independent and progressive skill development during aquatic activities.

The adapted swimming program featured a progressive difficulty structure comprising preparation activities, breathing exercises, control and balance tasks, individual movement games, swimming skill exercises, cooperation and independence activities and cool-down routines. Once participants mastered initial skills, they advanced to more complex tasks requiring higher coordination and execution. Meanwhile, children still developing foundational competencies continued practicing basic variations without disrupting the group flow. This adaptive progression ensured that every participant engaged at their own developmental pace.

Control group participants did not join the adapted swimming program. However, the intervention was made available to them following post-test measurements. Additionally, the aquatic program continued to run after the completion of the study for all interested individuals with ASD and ID.

Statistical Analysis

Data were analyzed using non-parametric statistical procedures. Within each group, the Wilcoxon signed-rank test evaluated differences between pre- and post-intervention measurements. The Mann-Whitney U test compared independent groups (experimental vs. control) and disability categories (ASD vs. ID). Spearman's rank-order correlation coefficients examined the relationships between WOTA-1 and A-SEAS (aquatic skills) scores, as well as between A-SEAS Emotional Adjustment and ERC scores. The strength of significant correlations was interpreted using guidelines by Portney and Watkins (2009). Statistical significance was set at $p < .05$. All analyses were conducted using IBM SPSS Statistics (Version 29).

Results

The Mann-Whitney U test results revealed statistically significant differences between the EG ($n = 17$) and CG ($n = 13$) in post-intervention measures, favoring the EG participants. Specifically, significant differences were found in WOTA 1 ($U = 0.00$, $p = .001$), A-SEAS aquatic skills ($U = 9.00$, $p = .001$), A-SEAS Emotional Adjustment ($U = 0.50$, $p = .001$), ERC ($U = 13.00$, $p = .001$), ERC Emotion Regulation (ERC-ER; $U = 36.00$, $p = .002$), and ERC Lability/Negativity (ERC-LN; $U = 27.50$, $p = .001$). No statistically significant differences were observed between the two groups across all pre-intervention measurements (Table I).

Table I. Control Experimental differences in pre- and post-measures

Factors	Group	Mean Rank	Mann-Whitney U	Asymp. Sig.
ERC ER pre	EG	15.06	103.000	.751
	CG	16.08		
ERC ER post	EG	19.88	36.000	.002
	CG	9.77		
ERC LN pre	EG	15.79	105.500	.833
	CG	15.12		
ERC LN post	EG	10.62	27.500	.001
	CG	21.88		
Total ERC pre	EG	14.82	99.000	.65
	CG	16.38		
Total ERC post	EG	21.24	13.000	.001
	CG	8		
WOTA-1 pre	EG	16.18	99.000	.65
	CG	14.62		
WOTA-1 post	EG	22	0	.001
	CG	7		
ASEAS aquatic skills pre	EG	15.94	103.000	.751
	CG	14.92		
ASEAS aquatic skills post	EG	21.47	9.000	.001
	CG	7.69		
ASEAS Emotional Adjustment pre	EG	14.74	97.500	.583
	CG	16.50		
ASEAS Emotional Adjustment post	EG	21.97	.500	.001
	CG	7.04		

On the total sample of all participants with ID and ASD, non-parametric Wilcoxon analysis demonstrated statistically significant improvements between pre- and post- measurements across all subscales (WOTA 1, A-SEAS aquatic skills, A-SEAS Emotional Adjustment, ERC, ERC-ER, and ERC-LN) exclusively for the EG (Table II).

Table II. Wilcoxon results pre and post results

Factors	Group	N	Measures	Mean Rank	Z	p
ERC - ER	EG	17	pre	0	-3.633	.001
			post	9		
	CG	13	pre	0	0	1
			post	0		
ERC - LN	EG	17	pre	0	-3.628	.001
			post	9		
	CG	13	pre	0	0	1
			post	0		
WOTA1	EG	17	pre	0	-3.627	.001
			post	9		
	CG	13	pre	0	-1.342	0.5
			post	0		
ASEAS aquatic skills	EG	17	pre	0	-3.625	.001
			post	9		
	CG	13	pre	0	0	1
			post	0		
ASEAS Emotional Adjustment	EG	17	pre	0	-3.626	.001
			post	9		
	CG	13	pre	0	0	1
			post	0		

A Spearman's rank-order correlation was conducted to examine the relationship between WOTA-1 and A-SEAS Aquatic Skills scores in 30 participants ($N=30$). Results indicated a strong, positive, and statistically significant correlation between the two variables ($r_s = .907$, $p = .001$) (Table III).

Table.III Spearman correlation WOTA1 – A-SEAS

	WOTA1	A-SEAS
WOTA1	1.00	.907**
A-SEAS	.907**	1.00

Note. $N = 30$. Spearman's rho coefficients are reported. $p < .01$ (two-tailed)

Similarly, a strong and statistically significant positive correlation was observed between A-SEAS Emotional Adjustment and ERC scores ($r_s = .721$, $p = .001$) (Table. IV).

Table. IV. Spearman correlation A-SEAS Emotional Adjustment -ERC

	A-SEAS Emotional Adjustment	ERC
A-SEAS Emotional Adjustment	1.00	.721**
ERC	.721**	1.00

Note. $N = 30$. Spearman's rho coefficients are reported. $p < .01$ (two-tailed)

Discussion

The purpose of this study was to examine the effects of an adapted swimming program with visual prompts on aquatic skills and emotional regulation in children with Autism Spectrum Disorder (ASD) and Intellectual Disability (ID). The results revealed significant post-intervention differences between the EG and the CG) across measures of aquatic competence (WOTA-1 and A-SEAS aquatic skills) and emotional regulation (ERC and A-SEAS Emotional Adjustment), with participants in the EG demonstrating superior outcomes. Furthermore, significant improvements were observed only among participants in the EG, providing evidence for the effectiveness of the intervention. Taken together, these findings suggest that a structured aquatic program combined with visual prompts may enhance both aquatic skills and emotional regulation in children with ASD and ID.

These results are consistent with previous studies demonstrating that aquatic interventions can improve motor and aquatic skills in children with ASD and ID (Tsolaki et al., 2023). To our knowledge, no previous study has examined both disability groups within the same research design. Therefore, comparisons were made with studies investigating children with ASD and ID separately, which have consistently reported significant improvements in aquatic skills following adapted swimming interventions among children with ASD (Ansari et al., 2021; Caputo et al., 2018; Chu & Pan, 2012; Güeita-Rodríguez et al., 2021; Pan, 2010; Vodakova, 2022) and children with ID (Bataglion et al., 2018; Boer & de Beer, 2019; Hakim et al., 2017; Hartlage et al., 2021; Kim et al., 2018; Milligan et al., 2022). These findings suggest that aquatic programs combined with visual supports provide a meaningful context for promoting both functional and emotional outcomes, consistent with previous research (Pan, 2010). In particular, the observed improvements in aquatic and adaptive skills further support the effectiveness of structured water-based interventions.

Notably, the present findings extend the research trajectory initiated by Tsolaki et al. (2023), who demonstrated that participation in a community-based therapeutic swimming program improved both aquatic readiness and emotional satisfaction among children with ASD and ID. While emotional satisfaction represented an important first indicator of positive affective responses to aquatic participation, the current study provides stronger evidence by documenting significant improvements in emotional regulation using both parent-reported (ERC) and observational (A-SEAS Emotional Adjustment) measures. These findings suggest that the benefits of adapted swimming may extend beyond enjoyment and satisfaction, contributing to broader emotional self-regulation processes that are critical for adaptive functioning in children with neurodevelopmental disorders.

Furthermore, the use of the A-SEAS instrument developed by Kokaridas et al. (2025) allowed for a more comprehensive assessment of intervention outcomes. Unlike traditional aquatic assessments that focus exclusively on motor performance, A-SEAS evaluates emotional adjustment simultaneously with aquatic skill performance. The significant improvements observed in both dimensions support the theoretical rationale underlying the scale and provide further empirical evidence that emotional adaptation and motor learning are closely interconnected processes within aquatic intervention settings. Consequently, the present findings not only support the effectiveness of the adapted swimming program but also reinforce the practical value of A-SEAS as a specialized assessment tool for children with ASD and ID.

The present study extends previous evidence by highlighting improvements not only in aquatic skills but also in emotional regulation (ER) and broader behavioral functioning. These emotional gains may be driven by water-based activities that facilitate attachment behaviors (e.g., proximity seeking), creating a secure base for emotional regulation (Caputo et al., 2018; Pan, 2010). Additionally, the sensory-motor demands of aquatic environments enhance perceptual processing and motor control, further supporting emotional and behavioral

stability (Marzouki et al., 2022). Similar parent-reported improvements in emotional stability, reduced frustration, and increased calmness were observed by Alecu and Onea (2025).

While research on aquatic interventions for children with intellectual disabilities (ID) has largely focused on physical and motor outcomes, ER has received limited attention despite its critical impact on quality of life. This study addresses this significant literature gap. Emerging evidence supports the calming, low-impact benefits of aquatic environments. As an example, Petrescu et al. (2025) found that aquatic exercise reduced emotional symptoms and improved prosocial behavior in adolescents with Down syndrome, even though no significant changes were noted for hyperactivity or peer difficulties. These findings support the notion that aquatic environments facilitate ER, likely due to their calming and low-impact nature.

Regarding instrument validation, the strong positive correlation between the A-SEAS and the WOTA-1 demonstrates excellent convergent validity, confirming that the A-SEAS effectively measures aquatic competence in children with ASD and ID. This high level of agreement indicates that both tools assess closely related skill constructs. Importantly, while the A-SEAS aligns with a gold-standard measure like the WOTA-1, it is specifically tailored to the target population of this study. Furthermore, the strong but imperfect overlap between the two instruments suggests that the A-SEAS retains unique sensitivity to performance aspects specific to structured aquatic interventions, moving beyond traditional skill-based evaluation.

These findings are particularly important since they provide additional external validation evidence for the A-SEAS, extending the psychometric findings originally reported by Kokaridas et al. (2025). The strong convergence with WOTA-1 and the substantial association between A-SEAS Emotional Adjustment and ERC, suggest that the instrument successfully captures both functional aquatic competence and emotional adaptation. Therefore, the present study represents the first intervention-based application of A-SEAS, demonstrating its sensitivity to change following a structured aquatic intervention.

Along with aquatic competence, the A-SEAS incorporates an emotional adjustment dimension to capture children's behavioral and affective responses during swimming activities. The positive association between this dimension and the ERC supports its construct validity, indicating that emotional behaviors during structured aquatic activities reflect broader, parent-reported emotional regulation in everyday life. Consequently, the A-SEAS offers a more comprehensive, multidimensional framework than traditional measures by integrating motor performance with emotional adaptation. This dual focus provides a holistic understanding of how children with ASD and ID respond to aquatic programs, enhancing its utility for intervention research. This methodological approach aligns with previous studies using correlations between standardized instruments to explore relationships among related variables (Danisman et al., 2016; Sörman et al., 2022), including performance-based assessments in sports science (Chang et al., 2020).

Overall, the positive outcomes observed suggest that an adapted swimming program incorporating structured visual prompts represents a promising intervention approach for children with ASD and ID. By combining adapted aquatic instruction with visual supports, the program promotes self-exploration, progressive skill development, and emotional engagement within a supportive environment. These features may have contributed not only to improvements in aquatic competence but also to the observed gains in emotional regulation, highlighting the value of visually supported aquatic interventions for children with ASD and ID.

Conclusions

This study contributes to the growing body of research on adapted swimming interventions for children with ASD and ID by demonstrating the effectiveness of an adapted swimming program incorporating visual prompts that offers a credible dual-purpose strategy that simultaneously advances motor competence and psychological well-being. Using the Adapted Swimming and Emotional Adjustment Scale (A-SEAS) alongside established measures of aquatic competence like the WOTA-1 and ERC, this research firmly establishes that aquatic skill acquisition and emotional regulation (ER) are not isolated developmental pathways, but rather deeply interconnected dimensions of a child's growth.

The significant improvements observed in the experimental group demonstrate that structured aquatic interventions when combined with sequential visual prompts can systematically lower the cognitive load of complex motor tasks. By replacing complex verbal instructions with clear, sequential picture cards and video prompts, this approach directly alleviates the frustration and anxiety typically experienced by children with ASD and ID during aquatic practice. Consequently, through this approach, the water environment shifts from a potential source of sensory overload into a predictable therapeutic space that fosters real-time behavioral adaptation. This allows children with ASD and ID to navigate physical transitions with increased independence, thereby lowering frustration, mitigating emotional dysregulation, and fostering a sense of self-efficacy and calmness.

A key focus of this study is the integration of physical and behavioral objectives into a holistic, dual-purpose approach within adapted physical activity. Traditionally, such programs are designed to address motor skills and behavioral goals independently. This study offers an alternative by demonstrating that a well-structured adapted swimming session combined with visual prompts can address both outcomes concurrently. By presenting an evidence-based approach, the findings of this study can contribute to the development of more integrated instructional practices within adapted and therapeutic settings, offering practical and operational

utility for contributors in adapted sport organizations, rehabilitation centers and educational institutions. The strong associations observed between A-SEAS, WOTA-1, and ERC scores further support the multidimensional nature of aquatic intervention outcomes and reinforce the importance of assessing emotional adaptation alongside motor performance. These findings suggest that adapted swimming programs incorporating structured visual supports constitute an effective approach for children with ASD and ID.

Although limited by its relatively small sample size and the absence of long-term follow-up, this study highlights the potential benefits of visually supported aquatic interventions. Future research should employ larger samples, longer intervention periods, and follow-up assessments to determine the sustainability of the observed effects. Ultimately, the present findings indicate that an adapted swimming program with visual prompts can effectively enhance both aquatic competence and emotional regulation, thereby promoting the functional and psychosocial development of children with ASD and ID.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors didn't use of AI in the writing of the article.

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Conflicts of interest

The authors declare no conflict of interest.

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