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Ability Grouping in Swimming Pedagogy: Implications for the Integration of Swimming Abilities and Technical Skills

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Abstract

Questions of pedagogical effectiveness in physical education, especially regarding how students are grouped during instruction, remain important for designing effective skill-based curricula. This study aimed to examine the qualitative effects of ability-based grouping in university-level swimming education. A pre–post experimental design was used, involving two groups of students: an experimental group that received instruction in homogeneous groups based on their swimming abilities (n=37), and a control group taught in heterogeneous, alphabetically based groups (n=39). All participants followed the same swimming curriculum and were assessed using standardized measures of swimming abilities and swimming skills at the beginning and at the end of the course. In the control group, correlations between swimming skills and abilities showed a slight decrease, whereas in the experimental group they generally increased. Both groups retained a single-factor structure at the initial and final measurements. However, the control group showed a reduction in factor loadings and in the proportion of explained variance (from 79% to 74%). In contrast, the experimental group demonstrated stable factor loadings and a slight increase in explained variance (from 72% to 76%), indicating a more coherent integration of swimming skills and abilities. These findings suggest that grouping students based on their initial abilities can improve the coherence of learning outcomes and enhance pedagogical effectiveness in physical education. Considering the importance of swimming skills in everyday life, further researches are warranted.

Keywords: *physical education, teaching methods, learning, pedagogical approach, structural changes*

Introduction

Swimming represents a fundamental human movement skill with significant implications for health, safety, and lifelong physical activity (Biró, Müller, Lenténé Puskás, Pucsok, & Czeglédi, 2020; Ferreira, Santos, Palmeira, Fernandes, & Costa, 2024; Rastovski, Zoretić, Šiljeg, & Jorgić, 2023). As both a survival skill and a structured form of physical exercise, swimming contributes to the development of cardiovascular fitness, motor coordination, and overall physical literacy. Moreover, the ability to swim is closely associated with drowning prevention, which remains a global public health concern, particularly among children and adolescents. Beyond its safety-related importance, swimming is also recognized as an inclusive physical activity that can be adapted across different ages, abilities, and educational contexts (Watson & Neil, 2024).

Because of the all previously said, swimming instructions are important part physical education teacher education (Zenić & Grčić-Zubčević, 2005). Students are systematically educated in the proper execution of swimming techniques, with emphasis on biomechanical efficiency and technical precision across different strokes. Also, teaching processes include development and enhancement of students' swimming abilities in different swimming techniques (Dimitrić et al., 2022a). Further, particular importance is placed on acquiring competencies related to water safety, such as lifesaving techniques and rescue procedures (Dimitrić et al 2022b). Last, but not the least, students are introduced to the methodological

and pedagogical principles of teaching swimming, enabling them to effectively plan, organize, and implement swimming instruction in diverse educational contexts (Wiesner, 2008; Zenić & Grčić-Zubčević, 2005).

It is generally accepted that one of the key challenges faced by educators is the pronounced heterogeneity of students considering their initial swimming competence. More precisely, students often enter educational programs with highly diverse backgrounds, ranging from individuals with limited water confidence to those with well-developed technical skills and competitive experience (i.e., former water polo and/or swimming athletes). Such variability is related to technical proficiency, which translates to learning pace. Logically, heterogeneity of students creates significant pedagogical demands since in such environment the uniform instructional approaches will definitely lead to inadequacy (Zenić & Grčić-Zubčević, 2005; Zenič, Trajkovski, & Tomljanovič, 2011).

One of the commonly applied pedagogical approaches to addressing heterogeneity in physical education, including swimming instruction, is so-called "ability grouping" (Ireson & Hallam, 2001; Wilkinson & Penney, 2022). Ability grouping refers to the practice of organizing students into relatively homogeneous groups based on their current level of performance, skill, or competence. Within such an organization of teaching process, instruction can be more accurately planned and programmed according to students' specific needs. It enables teacher/instructor to be more precise in selection of the specific tasks, allows appropriate progression of teaching contents, but also, to have better feedback from students. Theoretically, this approach allows teacher to better control the level of task difficulty, ensure adequate time-on-task, and create learning conditions that are optimal for each ability-based group. In general, the ability grouping is often considered a practical strategy for enhancing efficiency of teaching and improve and learning effectiveness (Ireson & Hallam, 2001). In the context of swimming this is particularly important. Specifically, in swimming education previously explained differences in knowledge and skills between students can be directly related to safety of participants, which is not so common in other activities and sports.

Despite its apparent pedagogical advantages, ability grouping has been criticized within educational and physical education literature. One of the primary concerns relates to the potential for social stratification and the reinforcement of perceived ability hierarchies among students. Placement into lower-ability groups may lead to the internalization of negative self-perceptions, reduced motivation, and diminished engagement in the learning process. Also, such grouping practices can contribute to forms of implicit labeling, where students are categorized in ways that may limit their opportunities for development and interaction (Boaler, Wiliam, & Brown, 2000; Hallinan, Bottoms, Pallas, & Palla, 2003). However, in the case of swimming curriculum the necessity for ensuring the safe environment cannot be overvalued, and therefore theoretical negative consequences of ability grouping are probably less important.

Existing research has already examined the effects of ability grouping on learning outcomes in physical education, including swimming. However, these investigations have predominantly focused on differences in the level of performance, skill acquisition, or affective responses among students. For example, Cernilec et al. studied alternating homogeneous and heterogeneous grouping in endurance and basketball (ages 11-15) and found higher pleasure levels with alternating formats regardless of ability level (Cernilec, Cotic, Felda, & Doz, 2023). Mahedero et al. (2021) compared homogeneous vs. heterogeneous skill grouping in a 12-lesson mini-volleyball, and found no significant difference between grouping strategies on game performance or knowledge. The US study compared homogeneous vs. mixed-skill graded competition in mini-handball (elementary students), and authors reported that lower-skilled students were disadvantaged in mixed conditions while ability grouping benefited most girls and especially lower-skilled students (Hastie, Ward, & Brock, 2017). Finally, in studies on swimming, authors showed superior effects of ability grouping in improvement of swimming abilities among young adult males, which was later accompanied by report on favorable effects even in improvement of swimming skills (Zenić & Grčić-Zubčević, 2005; Zenić, Trajkovski & Tomljanović, 2011).

Although ability grouping was already investigated in the context of quantitative improvements of skills and abilities, less attention has been given to the underlying structural relationships between variables that constitute the learning process itself. In the case of swimming this is particularly important since swimming technique (skills), and swimming abilities (results at different swimming disciplines) are logically intercorrelated and interdependent. Therefore, learning in swimming can be understood not only as an improvement in isolated variables, but also as a process of increasing integration between abilities and skills. Therefore, examining changes in the correlational structure among these variables may provide deeper insight into qualitative transformations that are not evidenced by traditional result-based quantitative analyses.

Accordingly, the aim of this study was to examine the effects of ability grouping on changes in the correlational structure between variables of swimming abilities and swimming skills in students of kinesiology (university physical education program). More specifically, the study sought to determine whether ability grouping leads to a higher degree of functional integration between knowledge- and ability-domain compared to a non-systematic (heterogenous) grouping approach. Initially, we hypothesized that educational process based on ability grouping will result in better integration of swimming skills and swimming abilities, than educational process based on heterogenous grouping of participants.

Methods

Participants and educational program

A total of 76 male university students of University of Split, Croatia (21±0.8 years), all in good health, participated in this study. Prior to participation, all participants were informed about the aim of the study, and provided informed consent. The sample was divided into an experimental group

(N=37) and a control group (N=39). No significant differences were observed between the groups in the initial status of swimming abilities.

The control group participated in the swimming curriculum organized into three heterogeneous subgroups formed on a non-systematic basis (e.g. alphabetical order). Additional analysis confirmed that these subgroups did not differ significantly in their initial swimming abilities. In contrast, the experimental group was organized using an ability grouping approach. Based on initial swimming performance, participants were classified into three homogeneous subgroups, which significantly differed in their swimming abilities (please see later for tested swimming abilities).

Both groups participated in an equivalent university swimming curriculum, with the same teachers. The program consisted of 60 instructional sessions (45 minutes each), conducted three times per week. The overall structure, objectives, and content of the sessions were consistent between the experimental and control group. However, differences emerged in the organization of instruction. While the control group operated within heterogeneous subgroups, the experimental group followed an ability-based grouping structure. Although the general objectives of each session were identical, the specific implementation and instructional adaptations varied according to the characteristics and needs of each subgroup. These variations were not predetermined but were dynamically adjusted throughout the program.

Variables

The sample of variables consisted of four indicators of swimming abilities, and four indicators of swimming skills. Swimming abilities included: freestyle 50 meters, backstroke 50 meters, butterfly 50 meters, and breaststroke 100 meters. All tests were done in accordance with standard FINA procedures. In addition to performance-based swimming ability variables, the study included indicators of swimming skills operationalized through expert assessment of technique execution. Specifically, overall swimming technique was evaluated for each of the four competitive strokes: freestyle, backstroke, breaststroke, and butterfly. Each technique was assessed by swimming instructor (corresponding author) using a standardized rating scale ranging from 1 to 5, where higher scores indicated a higher level of technical proficiency, and generally – better motor knowledge. The evaluation encompassed key elements of stroke execution, including body position, coordination, movement efficiency, and overall technical correctness. These variables were treated as indicators of swimming skills, reflecting the qualitative aspect of motor learning and the degree to which students had acquired and were able to demonstrate technically correct movement patterns.

All participants were tested at two time points: initial, at the beginning of the program, and final, at the end of the intervention period – swimming curriculum.

Statistics

The quantitative changes in the studied swimming abilities and skills were reported previously (Zenić & Grčić-Zubčević, 2005, Zenić et al., 2011). In the present study, the focus was on examining qualitative changes in the relationships between swimming abilities and swimming knowledge. Therefore, the statistical analyses in this research were directed toward the structural organization of variables.

In the first phase, correlation matrices were calculated separately, evidencing the relationships between swimming abilities and swimming skills. This was performed for both the experimental and control groups at the initial and final measurements. Changes in the strength and pattern of correlations over time were analyzed within each group to identify potential shifts in the relationships among variables. In addition, differences between corresponding correlation coefficients were tested using Fisher's z-transformation.

In the second phase, factor analyses were conducted to examine the underlying structure of the variable system at both measurement points for each group. By comparing factor structures obtained at the initial and final measurements, it was possible to assess whether the relationships among variables became more integrated, differentiated, or reorganized over the course of the program. Changes in factor loadings and the composition of latent dimensions were interpreted as indicators of qualitative transformations in the learning process.

Results

Table 1 presents the correlation matrices for the control group at the initial and final measurements. The negative coefficients are a result of opposite scaling of the skills and performances, but actually represents the positive associations. Also, the relatively strong correlations are understandable knowing the high variability of the results (i.e. students had highly different experience in swimming before the study). At the initial measurement, the control group demonstrated consistently high correlations among variables, with coefficients indicating strong associations across different swimming performances. The pattern of relationships suggests a relatively homogeneous structure, where performance in swimming skills is closely related to swimming abilities. At the final measurement, a general decrease in correlation coefficients can be observed across multiple variable pairs. Although the majority of correlations remained statistically meaningful, their strength was reduced compared to the initial measurement. This indicates a change in the pattern of relationships among variables over time.

Table 1. Correlations between swimming abilities (columns) and swimming skills (rows) for the control group in the initial and final measurement (*indicates statistical significance of p<0.05)

	Freestyle 50m	Butterfly 50m	Backstroke 50m	Breaststroke 100m
Initial measurement				
Freestyle technique	-0.91*	-0.82*	-0.77*	-0.74*
Butterfly technique	-0.84*	-0.86*	-0.78*	-0.66*
Backstroke technique	-0.87*	-0.85*	-0.78*	-0.78*
Breaststroke technique	-0.66*	-0.79*	-0.70*	-0.80*
Final measurement				
Freestyle technique	-0.87*	-0.70*	-0.71*	-0.62*
Butterfly technique	-0.84*	-0.78*	-0.69*	-0.58*
Backstroke technique	-0.87*	-0.66*	-0.74*	-0.61*
Breaststroke technique	-0.85*	-0.79*	-0.82*	-0.69*

Legend: Dark gray (≥0.85) – very strong correlation, Medium gray (0.75–0.84) – strong correlation, Light gray (0.65–0.74) – moderate correlation, White (<0.65) – lower correlation.

A comparison of the correlation matrices for the control group between the initial and final measurements revealed a general decrease in the strength of relationships among variables. To further examine these changes, differences between corresponding correlation coefficients were tested using Fisher's z-transformation. The results indicated that most of the observed changes were not statistically significant ($|z|<1.96$), despite a consistent trend of reduced correlation strength across multiple variable pairs. Statistically significant differences were identified only in a limited number of cases. Specifically, the correlation between backstroke technique and butterfly performance showed a significant decrease ($z=-2.05$, $p<0.05$), while the correlation between breaststroke technique and freestyle performance demonstrated a significant increase ($z=2.05$, $p<0.05$). All other changes in correlation coefficients did not reach statistical significance.

When observed for the experimental group, correlations at baseline ranged from moderate to high, with noticeable variability in their magnitude, reflecting a less homogeneous structure compared to the control group. However, at the final measurement, correlations remained within a similar range, with several coefficients increasing relative to baseline. The overall pattern appeared more uniform, with less dispersion in the strength of associations across variables (Table 2).

Table 2. Correlations between swimming abilities (columns) and swimming skills (rows) for the experimental group in the initial and final measurement (*indicates statistical significance of p<0.05)

	Freestyle 50m	Butterfly 50m	Backstroke 50m	Breaststroke 100m
Initial measurement				
Freestyle technique	-0.89*	-0.65*	-0.67*	-0.73*
Butterfly technique	-0.86*	-0.78*	-0.74*	-0.74*
Backstroke technique	-0.83*	-0.75*	-0.83*	-0.69*
Breaststroke technique	-0.73*	-0.75*	-0.63*	-0.79*
Final measurement				
Freestyle technique	-0.91*	-0.74*	-0.63*	-0.66*
Butterfly technique	-0.88*	-0.84*	-0.60*	-0.77*
Backstroke technique	-0.83*	-0.73*	-0.86*	-0.72*
Breaststroke technique	-0.75*	-0.75*	-0.69*	-0.83*

Legend: Dark gray (≥0.85) – very strong correlation, Medium gray (0.75–0.84) – strong correlation, Light gray (0.65–0.74) – moderate correlation, White (<0.65) – lower correlation.

To further examine the changes in correlations for the experimental group, differences between corresponding correlation coefficients were tested using Fisher's z-transformation. The results indicated that none of the observed differences reached statistical significance ($|z|<1.96$ for all variable pairs). Although certain correlations demonstrated moderate increases or decreases, these changes were relatively small and consistent across the matrix. No individual variable pair exhibited a pronounced shift in the strength of association.

At the initial measurement, factor analysis of the control group resulted in a single-factor solution, with all variables loading highly on the extracted factor (79% of the total variance explained). This indicated a strong and cohesive underlying structure. At the final measurement, the one-factor solution was retained. However, several loadings decreased and the explained variance dropped to 74%, suggesting a reduced contribution of the study variables to the general factor (Table 3).

Table 3. Factor analysis of the swimming skills and abilities in the initial and final measurement for the control group

	Initial F1	Final F1
Freestyle technique	0.92	0.87
Butterfly technique	0.96	0.94
Backstroke technique	0.93	0.85
Breaststroke technique	0.83	0.91
Freestyle 50m	-0.84	-0.82
Butterfly 50m	-0.90	-0.84
Backstroke 50m	-0.87	-0.87
Breaststroke 100m	-0.85	-0.74
Explained variance	6.32	5.89
Proportion total	0.79	0.74

Table 4 presents the results of the factor analysis for the experimental group at the initial and final measurements. At the initial measurement, a single-factor solution was identified, with all variables demonstrating relatively high factor loadings. The extracted factor accounted for 72% of the total variance. At the final measurement, the single-factor structure was retained. Factor loadings remained generally stable, with several variables showing slight increases. Additionally, the proportion of explained variance increased to 76%, suggesting a strengthening of the contribution of the extracted factor.

Table 4. Factor analysis of the swimming skills and abilities in the initial and final measurement for the experimental group

	Initial F1	Final F1
Freestyle technique	-0.88	-0.89
Butterfly technique	-0.90	-0.93
Backstroke technique	-0.87	-0.87
Breaststroke technique	-0.80	-0.89
Freestyle 50m	0.87	0.92
Butterfly 50m	0.84	0.86
Backstroke 50m	0.79	0.79
Breaststroke 100m	0.81	0.82
Explained variance	5.73	6.11
Proportion total	0.72	0.76

Discussion

The present study aimed to examine whether ability grouping influences the structural relationships between swimming abilities and technique-related knowledge (swimming skills). The findings indicate that different pedagogical grouping approaches are associated with distinct patterns of change in the organization of these variables. While the control group demonstrated a tendency toward weakening relationships and a reduction in the coherence of the underlying factor structure, the experimental group showed stable or slightly strengthened associations, accompanied by a consolidation of the latent structure. Therefore, our initial study hypothesis can be accepted. In the following text we are discussing some theoretical and practical aspects of evidenced qualitative changes, including: (i) differences in pedagogical approach, (ii) specific of swimming training applied, and (iii) social context of swimming curriculum organized vs. non-organized in ability groups.

Pedagogical approach(es)

One of the most probable explanations for the observed differences in qualitative changes can be found in the pedagogical specifics and specific advantages related to ability grouping. This is particularly characteristic in relation to differentiated instruction. In swimming, effective learning requires continuous alignment between task difficulty and the learner's level of competence. Even small mismatches between demand of the task and student's ability to perform the given task may lead to inefficient practice. Importantly, it often result in the reinforcement of incorrect movement patterns. This is the case in most physical education and sport-related curriculums, but due to the specific instructional conditions this is particularly problematic in swimming classes. Namely, unlike many other activities, where the instructor can remain in close proximity to learners and provide immediate, direct corrections, swimming instruction is typically conducted with the teacher positioned outside the water (Lepore, Columna, & Lizner, 2015). Therefore, teacher is not able to act immediately when student's mistake is evidenced.

Such spatial separation limits the immediacy and frequency of feedback. It makes precise task selection and group organization in swimming even more critical for effective learning. When students are grouped according to their abilities, teacher is able to design and implement instruction that corresponds to the specific needs of each subgroup. This includes not only the selection of appropriate drills, but also the sequencing of learning tasks and the regulation of task complexity, which are essential for progressive skill acquisition. In general, such an approach is consistent with the principles of differentiated pedagogy, where instruction should be intentionally adapted to optimize individual learning trajectories (Tomlinson, 2014). Therefore, in swimming classes organized on the principle of ability grouping, the problems related to spatial separation of student and teacher is not so pronounced.

Beyond task selection, ability grouping allows for a more precise management of the teaching process itself. In heterogeneous settings, instructors are often required to simultaneously address a wide range of technical issues, which can dilute instructional focus and reduce the effectiveness of feedback. Specifically, when feedback is provided in heterogeneous groups, it regularly varies across students due to differences in their skill level and technical quality of the execution. As a result, instructors are in a situation to shift rapidly between different methods of teaching by providing different types of corrections for different students. This altogether clearly reduces the precision and relevance of feedback for each individual.

In contrast, ability grouping enables a more focused instructional approach. In such class organization the needs are more "uniform", and different technical elements can be addressed more systematically. This creates conditions for more structured teaching episodes where most important aspects of specific technique can be accentuated, and where those aspects will be (likely) beneficial for majority of students in the group. We may say that because of the all previously said, the ability group can be observed as a way of increasing the pedagogical clarity and consistency, which are essential for motor learning in complex environments such as swimming (Schmidt, Lee, Winstein, Wulf, & Zelaznik, 2018; Titsworth, Mazer, Goodboy, Bolkan, & Myers, 2015).

In other words, the quality and specificity of feedback are substantially enhanced in ability-based groups, which represents a critical mechanism of teaching of motor knowledge. Motor learning theories emphasize that feedback must be both timely and relevant to the learner's current performance in order to be effective (Schmidt et al., 2018). In more homogeneous groups, instructors can provide more precise and context-specific feedback, targeting shared technical deficiencies and adjusting cues to the developmental level of the group. This reduces the likelihood of inappropriate or overly generic feedback, which is more common in heterogeneous settings. As a result, students in ability groups receive more meaningful information that can be directly integrated into their movement execution, facilitating the stabilization and refinement of technique.

Training specifics

In addition to pedagogical factors, the observed differences may also be explained through principles related to training load and physiological adaptation. In swimming, performance development is strongly influenced by the appropriate manipulation of training variables such as intensity and volume. Within heterogeneous groups, it is often difficult (even impossible) to prescribe optimal workloads that simultaneously suit all students. This leads to situations where students are either (i) undertrained or (ii) exposed to demands beyond their current capabilities (Zenić & Grčić-Zubčević, 2005). These problems are further amplified by the specific conditions of the aquatic environment. Unlike many land-based activities, swimming does not allow for precise and continuous monitoring of training load using commonly applied tools such as heart rate monitors or similar physiological indicators. As a result, both teacher and students have limited capacity to accurately assess the intensity and appropriateness of the workload in real time.

In heterogeneous groups, this limitation becomes particularly problematic, as large differences in ability make it difficult to estimate how individual students respond to the same training stimulus. Consequently, students in such settings may easily become either insufficiently stimulated or excessively fatigued, without clear feedback on their actual level of exertion. In contrast, ability grouping enables a more precise adjustment of training stimuli within each subgroup, allowing for better alignment between individual capacity and training demands. It is important to note that such an approach is consistent with fundamental training principles, which emphasize the importance of individualized load for effective adaptation and skill development (Bompa & Buzzichelli, 2018). From this perspective, the qualitative effects of ability grouping observed in this study may reflect not only pedagogical alignment but also more appropriate training stimuli, which support the coordinated development of performance-related capacities and technical execution.

Social environment(s)

Another specific explanation for the observed effects of ability grouping may be found in the differences in social dynamics between pedagogical approaches. In swimming instruction, where performance is highly visible and often directly comparable, the composition of groups can significantly influence students' motivation, self-perception, and engagement. In heterogeneous settings, lower-ability students may experience repeated exposure to more advanced peers, which can lead to unfavorable social comparisons, reduced self-efficacy, and increased frustration. As authors were directly involved in the educational program studied herein, we can highlight that previously explained issues related to heterogenous environment occasionally led to class absence among lower-achieving students. In contrast, ability grouping creates a more balanced social context. In such settings students are surrounded by peers of similar competence. It naturally reduced negative comparisons and promoted a more supportive learning climate.

Although being more related to training specifics, it is also important to note that in heterogenous classes, higher-ability students may receive less appropriate challenges, potentially reducing their level of engagement. Oppositely, in ability-based groups, teachers were able to apply adequate training stimuli for all students. For example, the most successful ones (competitive swimmers, and water polo players) were systematically trained using the high volume and intensities. Oppositely, the pedagogical process for low ability students often included low-volume tasks, allowing them to pay attention on skill execution and correcting the swimming technique.

All previously said can be interpreted through specific social frameworks such as social comparison theory and self-determination theory (Deci, Vallerand, Pelletier, & Ryan, 1991; Dijkstra, Kuyper, Van der Werf, Buunk, & van der Zee, 2008). When students perceive themselves as competent within their group, they are more likely to experience intrinsic motivation and sustained engagement in practice. Additionally, a more homogeneous social environment may facilitate peer interaction and cooperation, as students face similar challenges and progress at comparable rates (Ireson & Hallam, 2001). Such conditions can enhance the overall quality of practice and contribute to more stable learning processes, which probably happened even in this experiment.

Limitations and strengths

Several limitations should be acknowledged. The sample consisted exclusively of male physical education students, which limits the generalizability of the findings to other populations. In addition, the study was conducted within a structured curriculum, which ensured consistency but reduced greater variations in instructional variations. It should also be noted that the control and experimental groups belonged to different student generations, and therefore the possibility of selection bias cannot be entirely excluded.

The study also presents several notable strengths. A key one is probably the fact that all students were taught by the same teachers, which ensured consistency in teaching style, feedback, and instructional approach. Furthermore, the research was conducted under comparable working conditions, including identical curriculum structure, session frequency, and overall learning environment. Therefore, we believe that the study contributes to a relatively underexplored area, as investigations of structural changes in the relationships between performance and skill-related variables in swimming remain limited.

Conclusion

The findings of this study indicate that ability grouping is associated with more favorable structural (qualitative) changes in the relationships between swimming abilities and technique-related variables (swimming skills). While the control group demonstrated a tendency toward weakening associations and reduced coherence of the underlying factor structure, the experimental group showed stable or slightly strengthened relationships, along with a consolidation of the latent structure. These results suggest that ability grouping may facilitate a more integrated organization of motor performance. This is probable related to improved pedagogical efficacy, more proper organization and application of the training volume and intensity, but also favorable social structure associated with ability grouping.

From a practical perspective, the results support the implementation of ability grouping in swimming education in higher education settings. Therefore, educators and curriculum designers should consider incorporating structured ability-based grouping strategies as a means of optimizing both the quality and outcomes of swimming instruction.

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Conflict of interest

The authors declare no conflicts of interest.

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