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Effects of game-based swimming instruction on swimming skills and swimming-related self-confidence

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Abstract

Swimming instruction in elementary physical education requires approaches that support both basic swimming skills and confidence in swimming-related activities. However, evidence regarding whether structured game-based swimming instruction provides additional benefits over conventional instruction for these outcomes remains limited. This study examined basic swimming skills and swimming-related self-confidence among elementary-school students receiving game-based or conventional swimming instruction. A quasi-experimental pretest–posttest control-group design involved 100 purposively selected students aged 10–12 years from intact classes at two elementary schools in Makassar City, comprising an experimental group (n = 50) and a control group (n = 50), without individual random assignment. The experimental group completed 16 game-based swimming sessions over eight weeks, whereas the control group received conventional instruction with equivalent duration and targeted skill content. Basic swimming skills were assessed using a researcher-developed 18-item performance rubric and swimming-related self-confidence using a researcher-developed 12-item questionnaire; both instruments underwent content validation. Data were analyzed using descriptive statistics, paired-samples t-tests, and independent-samples t-tests. Both groups showed significant pretest-to-posttest changes in both outcomes ($p < .001$). The experimental group showed larger descriptive mean gains in basic swimming skills (27.42 vs. 14.64 points) and swimming-related self-confidence (23.78 vs. 10.48 points), with significantly higher immediate posttest scores for both outcomes ($p < .001$). Within this eight-week quasi-experimental intervention, game-based swimming instruction was associated with higher immediate posttest scores than conventional instruction, providing context-specific evidence for its use in elementary-school swimming education.

Keywords: Basic swimming skills, game-based swimming instruction, swimming education, swimming-related self-confidence.

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Authors contribution: a – Preparing concepts; b – Formulating methods; c – Conducting research; d – Processing results; e – Interpretation and conclusions; f - Editing the final version.

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INTRODUCTION

Swimming is an important component of physical education because it contributes to aquatic competence, motor development, and safe participation in water-based activities. At the elementary-school level, students are expected to develop fundamental skills such as water adaptation, floating, gliding, kicking, breathing, and movement coordination. However, learning these skills can be challenging when children experience fear of water, limited confidence, or difficulty engaging with technically demanding aquatic tasks. In Indonesia, conventional swimming instruction has also been associated with challenges such as low student enthusiasm and difficulties in mastering fundamental swimming skills (Ramadhani et al., 2022). These conditions highlight the need for instructional approaches that maintain systematic skill development while providing children with active and supportive learning experiences.

Game-based swimming instruction offers one potential approach by embedding targeted swimming skills within structured aquatic games rather than relying predominantly on teacher-directed technical drills. In the present study, game-based swimming instruction was organized around progressive activities addressing water adaptation, floating, gliding, kicking, breathing, and coordination. Its pedagogical rationale draws on three complementary perspectives. Constructivist learning emphasizes active and meaningful participation through interaction with learning tasks; motor-learning perspectives emphasize varied and progressively challenging practice for skill acquisition; and self-efficacy theory emphasizes mastery experiences as an important source of perceived capability in performing specific tasks (Button et al., 2020; Schunk & DiBenedetto, 2020; Wulf & Lewthwaite, 2016). Within swimming instruction, these principles are reflected in active participation in aquatic games, progressive and varied practice of fundamental swimming movements, and repeated opportunities to successfully complete increasingly challenging tasks.

These pedagogical characteristics are particularly relevant because learning to swim involves both motor performance and students' perceptions of their capability in the aquatic environment. In this study, self-confidence refers specifically to students' perceived confidence in performing and participating in swimming-related tasks rather than generalized confidence across situations. This construct is conceptually related to task-specific self-efficacy because successful experiences in aquatic tasks may strengthen students' beliefs about their ability to participate and persist in subsequent swimming activities. Swimming competence and confidence may therefore develop in a complementary manner: greater competence can provide successful performance experiences, while stronger confidence may encourage continued participation and practice. Examining both outcomes provides a broader perspective on swimming learning than assessing technical performance alone. Research on children's aquatic competence has similarly highlighted the relevance of psychological factors, including fear and confidence, to participation and competence in aquatic environments (Kauki et al., 2024; Minkels et al., 2025).

Existing evidence supports the use of playful and game-based approaches in physical and aquatic education. Recent studies indicate that game-based approaches can support motor-skill development, although outcomes vary according to intervention design, participant characteristics, and measures (Yan et al., 2022; Yusuf Hadi Putra, 2024). These findings complement motor-learning perspectives that emphasize varied, meaningful, and progressively challenging practice (Button et al., 2020; Rezki et al., 2025; Wulf & Lewthwaite, 2016). In swimming education, Ramadhani et al. (2022) reported improved learning outcomes through water-based games, while Sugiyanto et al. (2024) found that playful aquatic activities supported swimming competence and students' willingness to participate. Recent literature has also highlighted relationships among aquatic competence, confidence, and children's participation in swimming activities (Kurniawan et al., 2025; Minkels

et al., 2025). Taken together, this evidence supports incorporating structured games into swimming instruction. However, it remains unclear whether a progressively organized game-based approach offers additional benefits over conventional instruction when both basic swimming skills and swimming-related self-confidence are considered.

This gap is particularly relevant because limited evidence has examined an instructional approach that systematically combines active participation, progressive and varied aquatic practice, and opportunities for successful task completion within the same intervention. Previous studies have commonly focused on particular aquatic games, motor outcomes, or psychological responses separately, leaving the combined pedagogical contribution of these principles less clearly understood. Evidence from formal elementary-school physical education settings in Indonesia also remains limited. The contribution of the present study therefore lies in examining structured game-based swimming instruction in which aquatic games are systematically aligned with targeted swimming skills and theoretically informed principles of active learning, progressive motor practice, and confidence-building experiences. Conducting the study in Makassar City also provides context-specific evidence for elementary-school swimming education in Indonesia.

Based on this gap, the present study aimed to examine differences in basic swimming skills and swimming-related self-confidence between elementary-school students receiving game-based swimming instruction and those receiving conventional swimming instruction. It was hypothesized that students receiving game-based swimming instruction would demonstrate higher posttest basic swimming skills and swimming-related self-confidence than students receiving conventional instruction.

METHOD

Study Design and Setting

This study used a non-equivalent pretest–posttest quasi-experimental design to examine differences in basic swimming skills and swimming-related self-confidence between elementary-school students receiving game-based swimming instruction and those receiving conventional swimming instruction. The study was conducted in Makassar City during the second semester of the 2025/2026 academic year. Participants came from two elementary schools: 50 students from School A formed the experimental group and 50 students from School B formed the control group. Both groups received instruction at the same public swimming pool under comparable conditions. Separate schools were used to reduce potential treatment contamination. Group membership followed pre-existing intact classes; therefore, individual random assignment was not performed, and the findings were interpreted within the limitations of a non-randomized quasi-experimental design.

Participants and Sampling

The accessible population comprised 127 elementary-school students from the classes included in the study setting. Participants were selected using purposive sampling. All 127 students were assessed using the same predefined eligibility and aquatic-safety criteria: (a) active enrollment in the targeted classes; (b) age within the study range; (c) ability to understand basic instructions and participate safely in swimming activities; (d) absence of health conditions that made aquatic participation unsafe; (e) absence of severe fear of water that prevented safe participation; (f) written informed consent from a parent or guardian and age-appropriate student assent; and (g) willingness to participate throughout the study.

Following eligibility screening, 27 students were excluded because they did not meet one or more eligibility criteria. The final sample consisted of 100 students aged 10–12 years, with 50 students from School A in the experimental group and 50 students from School B in the control group. Group membership

followed the existing class structure rather than individual random allocation. No a priori power analysis was conducted; the accessible population and eligibility screening determined sample size. Because purposive sampling is a non-probability approach, generalizability to the broader elementary-school population is limited. All 100 participants completed the intervention and posttest assessments and were included in the final analysis. Complete outcome data were available for both outcomes, with no incomplete questionnaires or unscorable video assessments; therefore, no missing-data procedures were required. Participant flow was as follows: assessed for eligibility (n = 127), excluded (n = 27), included (n = 100), experimental group (n = 50), control group (n = 50), completed posttest (n = 100), and analyzed (n = 100).

Intervention Procedures

Both groups participated in 16 swimming sessions conducted over eight weeks, with two 60-minute sessions per week. Both instructional conditions addressed the same six components of basic swimming skills: water adaptation, floating, gliding, kicking, breathing, and coordination. The groups received the same instructional duration and targeted swimming content under comparable facility conditions, while differing primarily in the instructional approach.

The experimental group received game-based swimming instruction in which targeted swimming skills were embedded within progressively structured aquatic games. Activities progressed from water familiarization and basic body control to floating, gliding, kicking, breathing, and integrated movement coordination. The instructional approach incorporated varied and repeated practice while maintaining explicit swimming-skill objectives. Progression involved moving from assisted to independent performance, shorter to longer distances, isolated to combined skills, and simpler individual activities to more challenging goal-directed games.

Table 1. Examples of Game-Based Swimming Activities

Aquatic game	Targeted skill	Brief procedure and progression	Instructional objective
Treasure Hunt	Water adaptation	Students retrieved colored objects or toys from the water, with progressively greater facial and body immersion.	Develop water familiarization and confidence during immersion.
Starfish Float	Floating	Students maintained a star-shaped floating position, initially with assistance and progressively without assistance.	Develop buoyancy and body-position control.
Rocket Glide	Gliding	Students pushed away from the pool wall and glided in a streamlined position toward a target.	Develop streamlined body position and controlled gliding.
Kickboard Race	Kicking	Students moved toward a target using a kickboard while maintaining continuous kicking.	Develop consistent lower-limb propulsion.
Bubble Challenge	Breathing	Students practiced inhaling above the water and exhaling underwater by producing bubbles.	Develop controlled aquatic breathing.
Swimming Circuit Challenge	Coordination	Students combined gliding, kicking, breathing, and coordinated movement in a structured circuit.	Integrate previously practiced basic swimming components.

The control group received conventional swimming instruction over the same eight-week period, with two 60-minute sessions per week. The same six fundamental swimming components were practiced through teacher-directed explanation, demonstration, structured technical exercises, and repetition rather than game-based activities. Thus, both groups received comparable instructional duration and targeted the same basic swimming content under comparable facility conditions.

The experimental and control conditions were delivered by two different instructors, one for each condition. Both instructors had backgrounds in Physical Education, Sport, and Health and experience teaching swimming to elementary-school children. Before the intervention, the experimental-group instructor received specific orientation covering the 16-session structure, game procedures, activity progression, aquatic safety, student management, and use of the fidelity checklist. Intervention implementation was monitored using a

fidelity checklist addressing adherence to the planned instructional components and activity progression.

Participants were required to attend at least 80% of the 16 instructional sessions, corresponding to a minimum of 13 sessions. All participants met this attendance requirement; therefore, no participant was excluded from the final analysis because of insufficient attendance. Pretest assessments were administered before the intervention, and posttest assessments were conducted immediately after completion of the eight-week program. No delayed retention assessment was conducted.

Measures

Basic Swimming Skills

Basic swimming skills were assessed using a researcher-developed performance rubric informed by literature on children's aquatic competence and swimming-skill assessment (Minkels et al., 2025; Sundan et al., 2023). The rubric was developed through domain identification, indicator construction, expert review, revision, and pilot testing. It comprised 18 indicators covering water adaptation, floating, gliding, kicking, breathing, and coordination, with three indicators per component. Each indicator was scored from 1 to 4, producing a raw score ranging from 18 to 72, with higher scores indicating better performance. Scores were converted to a 0–100 scale using:

$$\text{Score (0–100)} = \frac{\text{Raw Score} - 18}{54} \times 100$$

Content validity assessment by three experts yielded an Aiken's V value of 0.89. Performances were video-recorded and independently scored by two assessors with physical education and swimming backgrounds and experience teaching and assessing children's swimming skills. Before scoring, both assessors were trained in rubric criteria, video-based assessment, practice scoring, and calibration. Inter-rater reliability, assessed using a two-way mixed-

effects ICC with absolute agreement, was 0.87. Full assessor blinding was not possible because contextual information could reveal participants' instructional conditions.

Swimming-Related Self-Confidence

Swimming-related self-confidence was assessed using a researcher-developed 12-item questionnaire designed to measure students' perceived confidence in performing and participating in swimming-related tasks. The

$$\text{Score (0–100)} = \frac{\text{Raw Score} - 12}{48} \times 100$$

instrument was developed through literature review, item generation, expert judgment, revision, and pilot testing and produced a single overall score. Throughout the study, the measured construct was treated specifically as swimming-related self-confidence rather than general self-confidence or self-efficacy. Items were rated from 1 to 5, yielding a raw score ranging from 12 to 60, with higher scores indicating greater swimming-related self-confidence. Scores were converted to a 0–100 scale using:

Content validity assessment by 3 experts yielded an Aiken's V value of 0.91. The questionnaire was pilot-tested with 30 students and demonstrated good internal consistency, with Cronbach's α = 0.86.

Data Collection, Safety, and Ethical Procedures

Data collection followed the same sequence for both instructional conditions: eligibility screening, parental consent and student assent, baseline assessment, allocation by intact classes, eight weeks of instruction with attendance and fidelity monitoring, and immediate posttest assessment. Before participation, parents or guardians received information concerning the study procedures and provided written informed consent, while participating students provided age-appropriate assent. Participation was voluntary. Eligibility

screening considered health conditions, the ability to participate safely in aquatic activities, and severe fear of water that could prevent safe participation.

Instruction was conducted in a shallow pool area approximately 0.8–1.2 m deep, with activities adjusted to students' abilities. Instructors, a lifeguard, and supervising personnel were present, and the number of students in the water was limited to maintain adequate supervision. Kickboards, flotation aids, and rescue equipment were available. If a student experienced difficulty or panic, the activity was stopped, and the student was assisted to a safe area before further participation was considered.

Ethical approval was obtained before data collection (No. 0173/KEPK-FIK/UNM/EC/2025). Participant codes were used in the analytical dataset, and identifying information was stored separately with access restricted to the research team. All 100 participants completed the posttest and had complete outcome data for the final analysis.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26, with the significance level set at $\alpha = .05$. Descriptive statistics were reported as means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Normality was assessed using Shapiro–Wilk tests and Q–Q plots, homogeneity of variance using Levene's test, and potential outliers using boxplots and standardized residuals. No extreme outliers required exclusion.

Paired-samples *t*-tests were used to examine pretest–posttest changes within each group because the measurements were obtained from the same participants over time. Independent-samples t-tests were used for the primary between-group comparisons of posttest basic swimming skills and swimming-related self-confidence because the experimental and control groups consisted of different participants. Mean gain scores were reported descriptively and were not inferentially compared between groups. No ANCOVA, mixed-design ANOVA, group × time interaction analysis, or baseline-adjusted analysis was

performed; therefore, between-group conclusions were limited to the posttest comparisons.

RESULTS

Participant Characteristics and Study Completion

A total of 127 students were assessed for eligibility. Twenty-seven students were excluded because they did not meet one or more eligibility criteria, resulting in a final sample of 100 participants. Of these, 50 students were included in the experimental group and 50 in the control group. All enrolled participants completed the intervention and posttest assessments and were included in the final analysis. Therefore, no attrition or missing outcome data occurred between the pretest and posttest assessments.

Participants were aged 10–12 years, with a mean age of 10.9 ± 0.8 years. Overall, 54% of the participants were male, and 46% were female. Previous swimming experience was reported by 38% of participants, whereas 62% reported no previous swimming experience.

Basic Swimming Skills

Descriptive statistics showed increases in basic swimming skill scores from pretest to posttest in both groups. The experimental group increased from 55.32 ± 8.45 at pretest to 82.74 ± 7.13 at posttest, corresponding to a descriptive mean gain of 27.42 points. The control group increased from 54.87 ± 7.96 at pretest to 69.51 ± 8.27 at posttest, with a descriptive mean gain of 14.64 points.

Table 2. Pretest and Posttest Basic Swimming Skill Scores

Group	n	Pretest *M* ± *SD*	Posttest *M* ± *SD*	Mean Gain	Within-group *p*
Experimental	50	55.32 ± 8.45	82.74 ± 7.13	27.42	< .001
Control	50	54.87 ± 7.96	69.51 ± 8.27	14.64	< .001

Paired-samples t-tests indicated statistically significant pretest-to-posttest changes in basic swimming skills within both groups ($p < .001$). The experimental group showed a descriptive mean gain of 27.42 points, compared with 14.64 points in the control group. The gain scores are presented

descriptively and should not be interpreted as evidence of a statistically significant between-group difference in change.

For the primary between-group analysis, the independent-samples t-test showed that the experimental group had a significantly higher posttest basic swimming skill score (82.74 ± 7.13) than the control group (69.51 ± 8.27; $p < .001$). Thus, the inferential between-group finding was restricted to the difference observed at posttest.

Distribution of Basic Swimming Skill Categories

Posttest basic swimming skill scores were additionally classified into four descriptive performance categories used in this study: Excellent (85–100), Good (70–84), Fair (55–69), and Poor (<55). This analysis provided supplementary descriptive information on the distribution of posttest swimming performance across the two groups.

Table 3. Distribution of Posttest Basic Swimming Skill Categories

Category	Score Range	Experimental Group n (%)	Control Group n (%)
Excellent	85–100	18 (36%)	4 (8%)
Good	70–84	25 (50%)	18 (36%)
Fair	55–69	7 (14%)	22 (44%)
Poor	<55	0 (0%)	6 (12%)
Total	—	**50 (100%)**	**50 (100%)**

The descriptive distribution showed that 43 students (86%) in the experimental group were classified in the Good or Excellent categories, compared with 22 students (44%) in the control group. Seven students (14%) in the experimental group were classified as Fair, and none were classified as Poor. In the control group, 22 students (44%) were classified as Fair and six students (12%) as Poor. These categorical findings were interpreted descriptively and were not subjected to inferential comparison between groups.

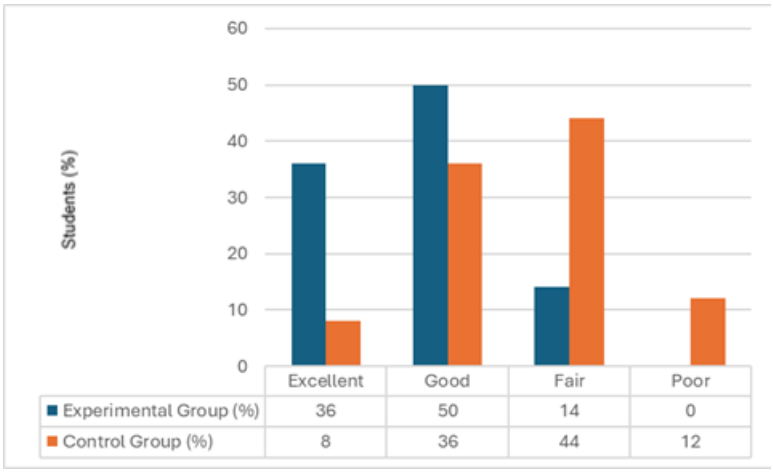

Figure 1. Distribution of posttest basic swimming skill categories in the experimental and control groups

Figure 1 illustrates the distribution of posttest basic swimming skill categories in the experimental and control groups. A greater proportion of students in the experimental group was classified in the Good and Excellent categories. In contrast, a larger proportion of students in the control group was classified in the Fair and Poor categories. The figure is presented as a descriptive visualization and does not represent an inferential comparison between groups.

Swimming-Related Self-Confidence

Swimming-related self-confidence scores also increased from pretest to posttest in both instructional groups. The experimental group increased from 62.18 ± 9.22 at pretest to 85.96 ± 6.84 at posttest, corresponding to a descriptive mean gain of 23.78 points. The control group increased from 61.85 ± 8.97 at pretest to 72.33 ± 8.54 at posttest, with a descriptive mean gain of 10.48 points.

The posttest distribution of swimming-related self-confidence was considered in relation to the possible concentration of scores near the upper end of the scale. However, the available summary data were insufficient to determine the proportion of participants scoring at or near the maximum score. Therefore, no definitive conclusion regarding a ceiling effect was made.

Table 4. Pretest and Posttest Swimming-Related Self-Confidence Scores

Group	n	Pretest *M* ± *SD*	Posttest *M* ± *SD*	Mean Gain	Within-group *p*
Experimental	50	62.18 ± 9.22	85.96 ± 6.84	23.78	< .001
Control	50	61.85 ± 8.97	72.33 ± 8.54	10.48	< .001

Paired-samples t-tests indicated statistically significant pretest-to-posttest changes in swimming-related self-confidence within both groups ($p < .001$). The experimental group showed a larger descriptive mean gain than the control group. However, the difference between these gain scores was not directly tested inferentially; therefore, the gain values were used only to describe the observed pattern of change.

For the primary between-group analysis, the independent-samples t-test showed that the experimental group had a significantly higher posttest swimming-related self-confidence score (85.96 ± 6.84) than the control group (72.33 ± 8.54; $p < .001$). Accordingly, the between-group inference was based on the posttest comparison rather than on a statistical comparison of gain scores.

DISCUSSION

The present study examined basic swimming skills and swimming-related self-confidence among elementary-school students receiving game-based or conventional swimming instruction. Both groups showed significant pretest-to-posttest improvements, while the experimental group demonstrated larger descriptive gains and significantly higher posttest scores for both outcomes. Because differences in gain scores were not directly tested inferentially, the larger gains should be interpreted descriptively rather than as evidence of statistically greater improvement over time. Nevertheless, the posttest comparisons indicate that game-based swimming instruction was associated with more favorable immediate outcomes than the conventional instruction implemented in this study. The improvement observed in the control group is equally important because it indicates that conventional instruction also supported learning.

The higher posttest basic swimming skill scores in the experimental group may be related to the organization of practice. The experimental condition incorporated water adaptation, floating, gliding, kicking, breathing, and coordination into progressively structured aquatic games. Varied aquatic tasks provided practice variability, progressive difficulty introduced graded task challenges, repeated exposure increased opportunities for practice, and movement exploration required students to adapt their actions to different aquatic constraints. These characteristics are consistent with motor-learning approaches emphasizing task-specific practice, feedback, demonstration, and manipulation of practice conditions in children's swimming instruction (Minkels et al., 2025). Recent evidence also indicates that different motor-learning approaches can support swimming and aquatic skill acquisition in children, although findings vary according to instructional characteristics and the outcomes assessed (Minkels et al., 2025).

The findings are also consistent with the broader literature on game-based physical education. Manninen et al. (2022) reported positive but heterogeneous effects of game-based approaches on motor-skill outcomes, indicating that their benefits are not uniform across instructional contexts and outcome measures. This distinction is relevant because the games used in the present study were structured around predefined swimming skills rather than replacing technical practice with unrestricted play. Accordingly, the observed findings may reflect the combination of explicit skill objectives with varied and progressively challenging practice. The heterogeneity reported in previous research further suggests that intervention design, participant characteristics, instructional context, and outcome measurement may influence the benefits associated with game-based approaches (Manninen et al., 2022).

Swimming-related self-confidence showed a similar pattern, with the experimental group obtaining higher posttest scores than the control group. Progressively challenging aquatic activities may provide repeated opportunities for successful task completion and perceived mastery. Research in physical

education suggests that game-based activities can contribute to positive learning experiences, engagement, and perceived competence when they are systematically aligned with instructional objectives (Gustian, 2020; Masrun et al., 2025). Evidence from children's swimming instruction also indicates that instructional processes involving practice, modeling, and feedback may influence both skill acquisition and perceptions of capability (Sugiyanto et al., 2024). However, the present study did not directly measure enjoyment, engagement, mastery experiences, or perceived competence. These factors therefore represent plausible explanatory processes rather than empirically demonstrated mediators.

The relationship between basic swimming skills and swimming-related self-confidence may also be reciprocal. Greater confidence may encourage students to participate more actively in aquatic tasks, whereas successful performance and repeated mastery of swimming skills may strengthen perceptions of capability. This interpretation aligns with self-efficacy perspectives, in which successful performance experiences contribute to beliefs about one's capability to perform related tasks. In an aquatic-learning context, previous research has also discussed the concurrent development of performance and perceived capability (Kurniawan et al., 2025). Nevertheless, this study did not examine the direction of this relationship, and no mediation analysis was performed. The reciprocal relationship between skill development and swimming-related self-confidence therefore requires direct examination in future studies.

The improvement observed in the control group should also be considered when interpreting the comparative findings. Conventional instruction involved teacher-directed explanation, demonstration, structured practice, repetition, and exposure to the same fundamental swimming content over the same instructional period. Demonstration, feedback, repeated practice, and structured exposure are established components of aquatic skill learning (Stallman et al., 2017). Regular practice, increasing familiarity with the

aquatic environment, and normal learning progression contributed to the improvements observed in the control group. These factors were not tested independently, but they suggest that the experimental condition should be interpreted relative to an active instructional comparison rather than an ineffective control condition.

From a theoretical perspective, the findings can be interpreted through complementary motor-learning, constructivist, and self-efficacy perspectives. Game-based aquatic activities provided varied motor practice and progressive task challenges while requiring active responses to movement problems. These experiences align with motor-learning principles that emphasize adaptation to task demands and with constructivist learning processes that position students as active participants in learning. Repeated successful completion of progressively challenging activities may simultaneously contribute to stronger perceptions of capability. Evidence from game-based physical education suggests that learning outcomes depend substantially on how game activities are aligned with specific instructional and movement objectives (Muniz-Pardos et al., 2019). Thus, varied practice, progressive challenge, active engagement, and opportunities for successful task completion provide a plausible integrated framework for understanding the concurrent patterns in basic swimming skills and swimming-related self-confidence. However, these pathways were not directly tested as mediating mechanisms.

From a practical perspective, progressively structured aquatic games may be incorporated into elementary-school swimming instruction when they remain aligned with explicit skill objectives and provide sufficient practice opportunities. The present findings specifically concern basic swimming skills and swimming-related self-confidence and should not be generalized to broader psychological outcomes or water-safety competence. Aquatic competence and water safety encompass additional cognitive, behavioral, situational, and movement-related components beyond the outcomes

assessed in this study (Peden & Franklin, 2020). Therefore, the findings support the instructional relevance of game-based activities within the measured outcomes rather than a general claim regarding comprehensive aquatic competence.

Several limitations should be considered when interpreting the findings. First, purposive sampling and the use of intact classes without individual randomization introduce potential selection bias and do not eliminate the possibility of unmeasured confounding. Group assignment also coincided with school/class membership, and the statistical analysis did not account for this clustering; therefore, school- or class-level influences cannot be completely separated from those associated with the instructional conditions. Second, different instructors delivered the instructional conditions, making it difficult to separate differences associated with instructional approach from possible instructor-related influences. Third, outcomes were assessed immediately after the eight-week intervention without a retention assessment, limiting conclusions regarding the persistence of the observed outcomes. The absence of retention and transfer assessments has also been identified as an important methodological limitation in children's swimming research (Wing Prasetya Kurniawan et al., 2020). Fourth, swimming-related self-confidence was assessed through self-report. It may therefore be susceptible to response bias, whereas performance-based assessment of swimming skills may retain some degree of rater subjectivity despite the instrument evaluation procedures. In addition, both outcomes were assessed using researcher-developed measures; therefore, the generalizability of the measurement findings should be considered within the psychometric evidence established for these instruments in the present study. Finally, enjoyment, engagement, motivation, perceived competence, and other potential explanatory mechanisms were not directly measured.

Future studies should employ randomized or cluster-randomized designs where feasible, include retention and transfer assessments, and replicate the

intervention across multiple schools and instructional settings. Stronger experimental designs and retention assessments are particularly important for strengthening causal and longer-term interpretations of children's swimming-learning outcomes (Ramadhani et al., 2022). Future research should also assess intervention fidelity and potential psychological mechanisms directly, including enjoyment, engagement, fear or anxiety, and perceived competence. Examining students with different baseline swimming abilities would further clarify whether responses to game-based swimming instruction vary according to initial competence. These approaches would allow the proposed motor-learning, constructivist, and self-efficacy pathways to be tested empirically rather than inferred from outcome patterns.

Overall, the present study adds context-specific evidence regarding the use of structured game-based activities in elementary-school swimming education. Game-based swimming instruction was associated with higher immediate posttest basic swimming skill and swimming-related self-confidence scores than the conventional instruction examined in this study. At the same time, improvements in both groups and the methodological boundaries of the quasi-experimental design support a cautious interpretation of these findings and provide a basis for more rigorous investigation of game-based swimming pedagogy.

CONCLUSION

Both instructional groups showed improvements in basic swimming skills and swimming-related self-confidence following the eight-week instructional period. The game-based group showed larger descriptive gains and significantly higher immediate posttest scores for both outcomes than the conventional-instruction group. Within the context of the present study, these findings suggest that integrating progressively structured aquatic games with targeted swimming-skill practice may provide a useful instructional approach for elementary-school swimming education.

The findings may inform teachers responsible for elementary-school swimming or aquatic education who seek to combine fundamental swimming-skill practice with active participation in structured aquatic activities. However, interpret the results within the sampled elementary-school context and the study's methodological boundaries, including the use of intact classes without individual randomization, different instructors across conditions, and an immediate posttest assessment without follow-up. The findings should therefore not be directly generalized to other populations or instructional settings. Further research using stronger controlled designs, broader educational settings, and follow-up assessments is needed to determine whether the observed outcomes are sustained over time and replicated across different aquatic-learning contexts.

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