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Research Article

Development and validation of a basic skill-based swimming training model for beginner athletes: An ADDIE approach

Martinus[1]*, Hilmy Aliriad[2], Karmila Utari[3], I Bagus Endrawan[4], Muhamad Rohadi[5]

[1] Department of Sport Education, Universitas Bina Darma, Indonesia
[2] Department of Physical Education, Health, and Recreation, Universitas Nahdlatul Ulama Sunan Giri, Indonesia
[3] Department of Management, Universitas Bina Darma, Indonesia
[4] Department of Physical Education, Universitas Bina Darma, Indonesia
[5] Department of Sport Coaching Education, IKIP PGRI Kalimantan Timur, Indonesia

*Corresponding author, email: martinus@binadarma.ac.id

ABSTRACT

Background: Mastery of basic swimming skills is foundational for the development of beginner athletes, yet structured, validated training models tailored to the Indonesian context remain scarce. Objective: This study aims to develop a basic skill-based swimming training model that is content-valid, practical, and effective in improving swimming technical ability in beginner athletes aged 8-12 years, through systematic, staged development procedures. Methods: The research used the Research and Development (R&D) ADDIE model approach with staged procedures: (1) drafting the initial model based on needs analysis, (2) expert validation by four active swimming coaching validators using the Content Validity Ratio (CVR) instrument with Lawshe's formula, (3) model revision based on validator feedback, (4) small-scale trial (n=12, one club), and (5) large-scale trial (n=40, four clubs). Model effectiveness was tested using the Wilcoxon Signed Rank Test, with effect size (r) reported. Result: Expert validation yielded a Content Validity Index (CVI) of 0.87, exceeding the minimum CVI of 0.75 for N = 4 validators. The practicality test resulted in a score of 84.2% (very practical). The large-scale trial showed significant improvement in all basic swimming skill components ($p < 0.05$), with total scores increasing from 58.4 +/- 7.2 to 76.8 +/- 6.1, and an effect size of r = 0.74 (large). Conclusion: The developed basic skill-based swimming training model has proven to be valid, practical, and effective for beginner athletes aged 8-12 years, and is feasible for widespread implementation by swimming coaches in Indonesia. Future research is recommended to test the model using controlled experimental designs, expand subject coverage to more geographically and culturally diverse contexts, integrate psychosocial variables (motivation, parental support, coach quality), and include long-term follow-up to assess skill retention.

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Basic skills; beginner athletes; content validity ratio; research and development; swimming; training model.

Introduction

Swimming is one of the aquatic sports that has strategic value in the physical, psychological, and social development of children from an early age (Alim, Supriatna, & Hanief, 2024). Among its various benefits, mastery of basic swimming skills not only contributes to sports performance but also serves as a fundamental aquatic life-saving skill for every individual facing the risk of drowning (Spillett, 2018). Data from the Xie et al. (2021) shows that drowning is one of the three leading causes of unintentional death worldwide, with children aged 1–14 years being the most vulnerable group. This fact confirms that swimming skill development from an early age is not merely a sports performance agenda but also a life safety investment with long-term impacts for individuals and society.

From the perspective of sports coaching science, the age range of 8–12 years is considered a sensitive period for the development of specific motor skills, including swimming skills. At this phase, children's neuromuscular systems are in the most responsive condition to technical training stimulation: myelination of motor nerve pathways occurs rapidly, inter-segmental coordination develops significantly, and motor learning capacity reaches its peak (Fransen et al., 2012; Libertus, 2020). Consequently, structured, evidence-based training at this phase will produce stronger technical foundations and more durable movement pattern adaptations than training initiated later in life (Açıkgöz, 2022; Howard et al., 2019; Salters & Benson, 2025). Conversely, the absence of proper technical stimulation at this stage risks the development of compensatory movement patterns that are difficult to correct later.

Basic swimming skills encompass four fundamental interconnected components: breathing technique, arm stroke coordination, leg kick, and body position/streamline in water. These four components cannot be mastered separately; mastery of one component becomes a prerequisite for developing the next component in the swimming motor hierarchy (Barbosa et al., 2010; Marinho et al., 2020; Matúš et al., 2021; Tsunokawa et al., 2019). Field facts show that many young athletes experience training progress barriers due to inadequate mastery of one or more of these components, which ultimately negatively impacts self-confidence, training motivation, and their long-term performance trajectory (Burkett, 2015; Gungor et al., 2025).

A review of the sports development research literature shows that structured training programs designed around basic skills consistently produce greater performance improvements than conventional, generic training programs (Chow et al., 2021; Costa et al., 2012; Kim, 2023; Varghese et al., 2025). The task-based learning approach in aquatic contexts, which emphasizes providing movement tasks according to actual ability and each athlete's zone of proximal development, has proven effective in improving not only technical skills but also intrinsic motivation, self-competence perception, and long-term skill (Chow et al., 2021; Davids et al., 2013; Mehari & Zeleke, 2026; Sheaff, 2023). However, most research supporting these findings was conducted in countries with established coaching infrastructure, so its transferability and relevance to the Indonesian context — which has different club characteristics, facility availability, coach qualifications, and socio-cultural backgrounds — still needs to be examined empirically.

An examination of swimming development conditions in Indonesia reveals several unresolved structural problems. First, the majority of training programs used by swimming clubs in Indonesia, especially outside major cities, remain traditional and are not systematically structured according to modern coaching principles (Ginting et al., 2025). These conditions persist alongside two further structural problems: a real gap between rapidly developing swimming coaching theory and the field practices of most coaches, and an evaluation process for beginner athletes that still relies heavily on subjective assessment rather than scientifically validated rubrics.

The research gap identified in this study consists of three interrelated dimensions. Substantively, studies on the development of swimming training models specifically designed for the Indonesian beginner athlete context are still very limited; most circulating models are generic and do not consider the specific characteristics of children's motor development during the 8–12 year golden age phase or the real conditions of swimming club infrastructure in Indonesia (Esen et al., 2023; Ginting et al., 2025; Prayoga, 2020; Wormhoudt, 2018). Methodologically, swimming training model development research in Indonesia rarely uses standardized and statistically measurable content validation procedures; most only rely on Likert scale score percentages without using content validity indices such as Content Validity Ratio (CVR), which has verifiable critical values (Baghestani et al., 2017; Polit & Beck, 2006; Riffe et al., 2023; Solikhin et al., 2023). Procedurally, the product development flow covering staged stages — from expert validation, revision based on feedback, small-scale trials, to large-scale trials — has not been consistently applied in sports training model development research in Indonesia, even though these stages are crucial to ensure product quality and feasibility before widespread dissemination (Branch, 2019; Sugiyono, 2013).

The novelty of this research lies in three aspects that, to the authors' knowledge, have never been simultaneously integrated in swimming training model development research in Indonesia: (1) systematic integration of the task-based learning approach with training periodization principles into eight progressive modules tailored to children aged 8–12 years; (2) the use of CVR with Lawshe's formula and four active swimming-coaching validators, producing a quantitative and replicable validity index rather than the subjective Likert-percentage approaches commonly used; and (3) a strict, transparent ADDIE-based development flow encompassing needs analysis, CVR expert validation, model revision, small-scale trial, and large-scale trial, enabling staged refinement before widespread implementation.

Based on the above framework, this research aims to develop a basic skill-based swimming training model that is valid, practical, and effective for beginner athletes aged 8–12 years in Indonesia. The specific objectives are to: (1) compile an initial draft based on field needs analysis; (2) validate model content using CVR by four swimming-coaching experts; (3) revise the model based on validator recommendations; (4) test practicality and effectiveness through staged trials; and (5) produce a final standardized product implementable by coaches across Indonesia.

Method

Research Design

This research used the Research and Development (R&D) ADDIE model approach (Branch, 2019) with staged procedures as illustrated in Figure 1.

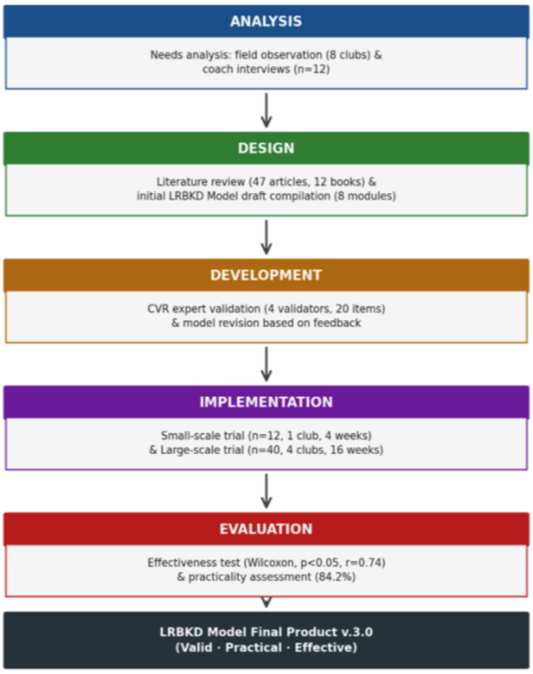

Figure 1. Development Procedure Flowchart of Basic Skill-Based Swimming Training Model

Participants

Small-scale trial subjects consisted of 12 beginner athletes (7 males, 5 females) aged 8–12 years from one swimming club in Surabaya. Large-scale trial subjects consisted of 40 beginner athletes (23 males, 17 females) aged 8–12 years (mean age: 10.3 ± 1.4 years; mean height: 138.5 ± 8.2 cm; mean weight: 34.7 ± 6.1 kg; mean BMI: 17.9 ± 2.3 kg/m2) from four swimming clubs in Surabaya City. Purposive sampling technique was applied with inclusion criteria: (1) never participated in official district-level or higher swimming competitions, (2) swimming training experience less than two years, (3) obtained written permission from parents or guardians, and (4) not currently in an injury recovery program. Exclusion criteria included athletes who were absent for more than 20% of total training sessions during the research.

Ethical Approval Statement

Ethical approval for this study was obtained from the Directorate of Research and Community Service (DRPM), Universitas Bina Darma, Indonesia. The study was reviewed and declared ethically feasible under Approval Number 001/SK/DRPM-UBD/II/2026, issued on February 2, 2026. Participation was voluntary, and all participants were informed of their right to withdraw from the study at any time without any consequences.

Initial Product and Expert Validation

The drafted initial model was then submitted to four expert validators to assess its content validity using the Content Validity Ratio (CVR) instrument. The four validators were selected based on strict expertise criteria: (1) having national swimming coaching certification from PRSI (Indonesian Swimming Federation) or equivalent international certification (FINA Level 2 or higher); (2) actively serving as beginner swimming coaches or swimming coaching lecturers with a minimum of 10 years of experience; and (3) having documented track records in early-age swimming athlete development. The composition of the four validators consisted of: Validator 1 (V1): PRSI Level 3 certified swimming coaching lecturer at State University of Surabaya with 15 years of experience; Validator 2 (V2): sports science lecturer at State University of Yogyakarta specializing in swimming biomechanics with 12 years of experience; Validator 3 (V3): head coach of a national swimming club certified PRSI Level 3 with 18 years of experience; and Validator 4 (V4): national award-winning youth swimming coach with FINA Level 2 certification and 11 years of experience.

The validation instrument used was a CVR assessment sheet developed based on Riffe et al. (2023) and modified according to the research context, following Baghestani et al. (2017) guidelines. In this instrument, each validator was asked to provide assessments in three mutually exclusive categories for each item: (1) "Not Necessary" — item is not relevant or does not contribute to the model's purpose; (2) "Useful but Not Essential" — item is relevant but not critical for model completeness; and (3) "Essential" — item is very important and the model would not be complete without it. The CVR value for each item was then calculated using the formula:

$$CVR = (ne - N/2) / (N/2) \quad (1)$$

where ne is the number of validators who stated the item is "essential," and N is the total number of validators. With N = 4 validators, the CVR value can range from -1.00 (no validators considered essential) to +1.00 (all validators considered essential). Based on Lawshe's critical value table updated by Baghestani et al. (2017), the minimum CVR value that must be met for an item to be declared valid at 95% confidence level for N = 4 validators is 0.75. Items with CVR ≥ 0.75 were retained in the model, while those with CVR < 0.75 were either fully revised or eliminated. The Content Validity Index (CVI) was then calculated as the arithmetic mean of all valid items' CVR values to describe the overall content validity level of the model.

The CVR validation sheet covered 20 assessment items evaluating three domains: (a) content validity — 8 items assessing the suitability of materials, techniques, and completeness of basic swimming skill components covered in the model; (b) construct validity — 7 items assessing the suitability of model structure, progressivity, training load, and evaluation instruments with motor development principles; and (c) practicality — 5 items assessing ease of implementation, time allocation suitability, and safety aspects of training procedures in actual swimming club conditions. In addition to CVR categorical assessments, each validator was also asked to write qualitative notes and specific improvement recommendations in the comment column. The validation process was conducted independently; each validator completed the assessment sheet without knowing the other validators' assessments to avoid confirmation bias.

Recommendations from validators supported by at least three validators (75% consensus) were directly implemented, while those supported by only one or two validators were further examined before being decided. The revision produced LRBKD Model v.2.0, which was then tested in stages: a small-scale trial (n=12, one club, four weeks) to identify implementation barriers and assess suitability, followed by a large-scale trial (n=40, four clubs, 16 weeks) as the final product recommended for widespread use.

Effectiveness Measurement Instrument

Model effectiveness in the large-scale trial was measured using a basic swimming skill assessment rubric covering four sub-components: (a) breathing technique — covering breathing timing, head rotation, and breath continuity (score 1–25); (b) arm stroke coordination — covering arm pull phase, push, and recovery (score 1–25); (c) leg kick — covering amplitude, frequency, and flutter kick efficiency (score 1–25); and (d) body position in water — covering horizontal balance, longitudinal body rotation, and head position (score 1–25), with a maximum total score of 100. This rubric was developed by the research team based on PRSI and FINA swimming technique assessment standards and subsequently validated by three PRSI-certified judges (Abdulghani & Hussain, 2025; Barbosa et al., 2013). Inter-rater reliability was confirmed with a Cohen's kappa of 0.86, indicating very good agreement (Caldwell et al., 2020; Viera & Garrett, 2005). Assessments were conducted anonymously, with each assessor unaware of the pretest/posttest conditions when assigning scores.

A practicality questionnaire with 24 Likert-scale 1–5 items (alpha = 0.91) was also administered to 12 coaches involved in the large-scale trial and to 40 athlete parents to assess ease of use, duration suitability, guide clarity, and overall model attractiveness. Questionnaire reliability was assessed using Cronbach's Alpha, which yielded a value of 0.91, indicating very high internal consistency.

Data Analysis

CVR validation data were analyzed using Lawshe's formula, with a critical CVR of 0.75 for N = 4 validators (Baghestani et al., 2017). The CVI value was calculated as the mean of all items' CVRs to describe the overall content validity of the model. Practicality data was analyzed descriptively using percentages with interpretation criteria: ≥ 81% (very practical), 61–80% (practical), 41–60% (fairly practical), and < 40% (not practical) (Akbar, 2013). For effectiveness testing, the Shapiro-Wilk normality test (because n < 50) was used to assess normality of the pretest and posttest data. Although Shapiro-Wilk indicated that the data met the normality assumption ($p > 0.05$), the Wilcoxon Signed Rank Test was deliberately selected as the primary inferential test on three substantive grounds: (1) the dependent variables were derived from an ordinal skill-assessment rubric (1–25 per component) rather than a true interval scale, so a nonparametric rank-based test is more appropriate to the actual measurement level of the data; (2) given a moderate sample size (n = 40), the Wilcoxon test offers greater robustness to potential outliers and mild deviations from distributional assumptions that Shapiro-Wilk may not detect at this n; and (3) using the Wilcoxon test maintains methodological conservatism, providing a more cautious estimate of effect than the paired-samples t-test would yield. Significance was set at alpha = 0.05, and effect size was calculated using the formula $r = Z/\sqrt{N}$ to measure the practical magnitude of the model's impact. All analyses were conducted using SPSS version 26.0 (IBM Corp., USA).

Results and Discussion

Results

Needs Analysis and Initial Model Development Results

The needs analysis stage, conducted through observations at eight clubs and interviews with 12 coaches, produced a comprehensive needs map. As many as 75% of coaches admitted not having a standardized training model to guide, 66.7% reported that beginner athletes often experience skill transition barriers, 83.3% needed more objective evaluation rubrics, and 91.7% stated that the training programs used so far were improvisations based on personal experience, without written references. These findings confirmed the urgency of developing a systematic and evidence-based training model.

Based on the findings of the needs analysis and a literature review of 47 international journal articles, the initial draft of the LRBKD (Basic Skill-Based Swimming Training) model was compiled into eight progressive modules. The hierarchical module structure was designed based on motor principles from fundamental to complex: aquatic environment introduction and body adaptation to water (Modules 1–2), mastery of individual technique components (Modules 3–4), technique component integration (Module 5), competitive element mastery (Module 6), basic physical capacity development (Module 7), and consolidation and competition simulation (Module 8).

Expert Validation Results (CVR)

CVR assessment by four validators on 20 validation instrument items was conducted over two weeks. Of the 20 items assessed, all obtained CVR values ≥ 0.75, indicating that all items were valid and retained. The recapitulation of CVR results for all items in the three domains is presented in Table 1, covering each validator's assessment (E = Essential; P = Useful but not essential; T = Not necessary), each item's CVR value, and validity description.

Table 1. Expert Validation Results Using Content Validity Ratio (CVR)

No.	Assessment Item	Domain	V1	V2	V3	V4	CVR	Note
1	Suitability of training objectives with developed basic swimming skills	A. Content Validity	E	E	E	E	1.00	Valid
2	Suitability of training materials with characteristics of 8-12 year old beginner athletes	A. Content Validity	E	E	E	P	0.75	Valid
3	Accuracy of material presentation sequence from basic to complex components	A. Content Validity	E	E	P	E	0.75	Valid
4	Suitability of taught breathing technique with PRSI/FINA standards	A. Content Validity	E	E	E	E	1.00	Valid
5	Suitability of freestyle arm coordination instructions with swimming biomechanics theory	A. Content Validity	E	E	E	P	0.75	Valid
6	Accuracy of leg kick technique (flutter kick) displayed in modules	A. Content Validity	E	P	E	E	0.75	Valid
7	Correctness of body position (streamline) concept taught in model	A. Content Validity	E	E	E	E	1.00	Valid
8	Completeness of basic swimming skill components covered in model	A. Content Validity	E	E	P	E	0.75	Valid

Table 1. Continued

9	Suitability of model structure and stages with children's motor development principles	B. Construct Validity	E	E	E	P	0.75	Valid
10	Suitability of inter-module progressivity with athletes' zone of proximal development	B. Construct Validity	E	E	E	E	1.00	Valid
11	Accuracy of training load (volume and intensity) according to beginner athlete age	B. Construct Validity	E	E	E	E	1.00	Valid
12	Suitability of work-rest ratio with aerobic capacity of 8-12 year old children	B. Construct Validity	E	E	P	E	0.75	Valid
13	Integration of technical, physical, and psychological aspects (self-confidence in water) in model	B. Construct Validity	E	E	E	P	0.75	Valid
14	Suitability of evaluation instruments with basic swimming skill indicators	B. Construct Validity	P	E	E	E	0.75	Valid
15	Clarity of assessment rubric and achievement criteria for each component	B. Construct Validity	E	E	E	E	1.00	Valid
16	Clarity of instructions and coach guide language that is easy to understand	C. Practicality	E	E	E	E	1.00	Valid
17	Ease of model implementation in various swimming club facility conditions	C. Practicality	E	P	E	E	0.75	Valid
18	Suitability of time allocation for each training session with club schedule	C. Practicality	E	E	E	P	0.75	Valid
19	Safety and security aspects in every training procedure	C. Practicality	E	E	E	E	1.00	Valid
20	Model feasibility for independent use by coaches without special assistance	C. Practicality	E	E	P	E	0.75	Valid
	CVI (Content Validity Index) - Mean of all items' CVR						0.87	Very Valid

As shown in Table 1, the CVI value of 0.87 indicates that the model overall has very strong content validity, exceeding the set minimum threshold. Safety and security aspects, as well as training load suitability, obtained the highest CVR values (1.00), reflecting full consensus among the four validators regarding the cruciality of these two aspects in swimming training models for beginner athletes.

Model Revision Based on Validator Feedback

In addition to CVR assessments, the four validators provided 23 qualitative improvement recommendations, recorded in the comment sheet. Of the 23 recommendations, 15 (65.2%) were supported by three or four validators and were directly implemented, and 5 (21.7%) were supported by two validators and were further examined before being partially implemented. Three recommendations (13.0%) were made by only one validator and were not implemented, with no documented reasons.

Major improvement recommendations implemented included: (1) addition of three breathing drill variations in Module 2 specifically for athletes showing signs of water anxiety, including land-based breathing exercises before water exercises; (2) adjustment of work-rest ratio in Module 7 from 1:1 to 1:2 to better suit the aerobic capacity of children aged 8–10 years based on LTAD (Long-Term Athlete Development) guidelines; (3) addition of two indicators in Module 8 evaluation rubric, namely head position during breathing and breathing timing coordination with arm movement cycle; (4) simplification and standardization of instruction sentences in the coach guide to eliminate terminology ambiguity; and (5) addition of visual diagrams illustrating body position and technique movement in each module to facilitate coach and athlete understanding. All these changes have been integrated into the model before field trials were conducted.

Small-Scale Trial Results

The small-scale trial was conducted over four weeks on 12 athletes (mean age: 10.1 ± 1.2 years; 7 males, 5 females) from one swimming club in Surabaya, not included in the large-scale trial subjects. Evaluation results showed that coaches could implement the model without significant obstacles after reading the guide independently, with an initial practicality score of 81.4%. This value exceeds the minimum threshold for the very practical category (81%), indicating that the model is sufficiently operational for implementation.

Several specific findings from the small-scale trial requiring minor refinement included: (a) leg movement drill instructions in Module 3 required additional explanation regarding ideal kick amplitude for the 8–9 year age group; (b) daily evaluation sheets were considered too long and needed simplification to be more efficiently used by coaches in field conditions; (c) warm-up time allocation in Module 6 needed to be extended by 5 minutes to accommodate more intensive start technique training preparation needs. These three minor improvements were implemented before the large-scale trial began.

Table 2. Comparison of Pretest and Posttest Scores for Basic Swimming Skills in Large-Scale Trial (n=40)

Skill Component	Pretest Mean ± SD	Posttest Mean ± SD	Diff.	% Increase	p-value	Effect Size (r)
Breathing Technique (max. 25)	13.2 ± 2.1	18.7 ± 1.8	+5.5	41.7%	0.001*	0.72 (large)
Arm Stroke Coordination (max. 25)	14.8 ± 2.4	20.1 ± 2.0	+5.3	35.8%	0.001*	0.68 (large)
Leg Kick (max. 25)	15.3 ± 1.9	19.6 ± 1.7	+4.3	28.1%	0.002*	0.65 (large)
Body Position in Water (max. 25)	15.1 ± 2.3	18.4 ± 1.9	+3.3	21.9%	0.003*	0.61 (large)
Total Score (max. 100)	58.4 ± 7.2	76.8 ± 6.1	+18.4	31.5%	0.001*	0.74 (large)

Large-Scale Trial Results

The large-scale trial was conducted over 16 weeks on 40 beginner athletes from four swimming clubs in Surabaya. Of the 40 registered athletes, all completed the program with an average attendance rate of 94.7% (range: 87.5%–100%), exceeding the set minimum attendance threshold (80%). No athletes were excluded for attendance reasons. Large-scale trial practicality test results involving 12 coaches and 40 athlete parents yielded an average score of 84.2% (very practical). The ease of use aspect obtained the highest score (86.7%), followed by guide clarity (85.1%), while training duration suitability obtained the lowest score (81.3%) but remained in the very practical category.

Shapiro-Wilk normality test results indicated that the pretest ($W = 0.947$; $p = 0.061$) and posttest ($W = 0.952$; $p = 0.089$) data were normally distributed ($p > 0.05$). Comparison of pretest and posttest scores for basic swimming skills in the large-scale trial is presented in Table 2.

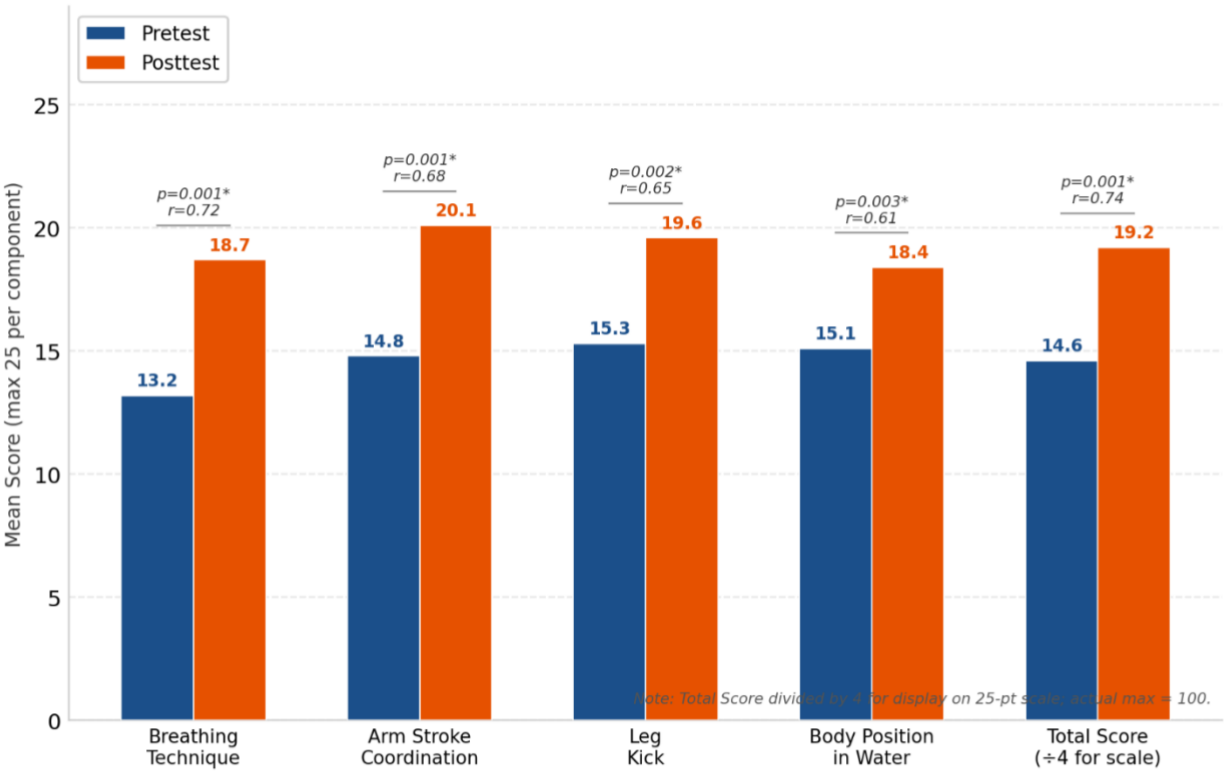

Figure 2. Pre-Post Comparison of Basic Swimming Skill Scores in the Large-Scale Trial (n=40)

As shown in Figure 2, all basic swimming skill components demonstrated statistically significant improvement ($p < 0.05$) after 16 weeks of model application. The largest percentage increase occurred in the breathing technique component (+41.7%), while the smallest increase was in body position in water (+21.9%). Effect sizes ranged from $r = 0.61$ to 0.74, all falling into the large effect category ($r \geq 0.50$). These findings confirm that the developed LRBKD model has a substantial practical impact and can be used effectively by students, including beginner athletes (Naratama et al., 2023; Suzatmika et al., 2023).

A complete summary of the development flow from initial model to final product is presented in Table 3, illustrating model development at each stage based on the evaluation results obtained. As presented in Table 3, the development of the LRBKD swimming training model followed a systematic process from needs analysis to large-scale implementation. The findings showed that the model achieved strong validity, with all CVR items ≥ 0.75 and a CVI score of 0.87, indicating that the product was considered highly valid by expert validators. Furthermore, the large-scale trial demonstrated high practicality (84.2%) and significant improvement across all training components ($p < 0.05$; $r = 0.74$), suggesting that the final LRBKD model was both feasible and effective for beginner swimming athletes.

Table 3. Summary of LRBKD Model Development Flow from Initial Draft to Final Product

No.	Stage	Main Activity	Results/Findings	Output
1	Needs Analysis	Field observation (8 clubs) & coach interviews (n=12)	75% coaches without standardized guide; identification of 5 critical gap areas	Needs map & product specifications
2	Initial Model Draft Development	Literature review (47 articles, 12 books) & module compilation	Draft model of 8 progressive modules (48 sessions, 16 weeks)	LRBKD Model Draft v.1.0
3	CVR Expert Validation	CVR assessment by 4 active swimming expert validators	All 20 items CVR ≥ 0.75; CVI = 0.87 (very valid)	Validated model + 23 improvement recommendations
4	Model Revision	Implementation of validator recommendations (15/23 directly, 5/23 after review)	20 improvements integrated; 3 not implemented with documented reasons	LRBKD Model Draft v.2.0
5	Small-Scale Trial	Implementation of 2 module cycles; n=12 athletes, 1 club	Practicality 81.4%; 3 minor refinement findings identified	LRBKD Model Draft v.2.1
6	Large-Scale Trial	Implementation of 8 module cycles (16 weeks); n=40 athletes, 4 clubs	Practicality 84.2%; significant improvement in all components (p<0.05; r=0.74)	LRBKD Model Final Product v.3.0

Discussion

Reliability of CVR Validation Procedure and Its Methodological Implications

The CVI value of 0.87, derived from the assessment of four active swimming expert validators, exceeded the minimum CVR threshold of 0.75 set by Baghestani et al. (2017) for n = 4 validators at the 95% confidence level. This result confirms that the developed training model content is highly relevant and can be scientifically accounted for in the domain of basic swimming skills. The use of the CVR instrument in this research is one of the methodological contributions that substantially differentiate it from previous swimming training model development studies in Indonesia (Ginting et al., 2025; Wormhoudt, 2018), which generally used Likert-scale score percentages without statistically standardized critical values.

The CVR approach has several advantages over simple percentage approaches. First, CVR explicitly distinguishes between items that are merely "useful" and those that are truly "essential"—a distinction that is crucial in model development, where every component must make a real contribution to the desired goals (Riffe et al., 2023). Second, CVR critical values can be independently verified using tables available in the literature (Baghestani et al., 2017), so other researchers can replicate or verify validation decisions. Third, CVR enables identification of weak items (low CVR) that need improvement, before products are tested (Polit & Beck, 2006). All three make CVR a stricter, more transparent, and more accountable approach than the conventional validation methods commonly used in sports training model development research in Indonesia.

Meaning of Revision Process Based on Validator Feedback

The revision process that accommodated 20 of 23 validator recommendations reflects a genuinely responsive development approach to practical field expertise. The addition of drill variations for water anxiety in Module 2, for example, was recommended by three of four validators based on their field experience, each of whom had worked with athletes with different water-fear responses. This is consistent with Huebner et al.'s (2021) findings, which show that water anxiety is a significant yet often overlooked barrier to the design of swimming programs for children. Appropriate handling from the beginning of the program increases participant retention and technical progress.

The adjustment of the work-rest ratio from 1:1 to 1:2 in Module 7, based on validator recommendations, also reflects the model's sensitivity to the physiological realities of beginner athletes. Aerobic capacity and tolerance to lactate accumulation in children aged 8–10 years are fundamentally different from adult athletes; forcing work-rest ratios that do not match not only reduces technical quality during training but potentially creates perceptions of excessive fatigue that negatively impact long-term (Howard et al., 2019; Pietzsch, 2020; Toubekis & Tokmakidis, 2013).

Model Effectiveness in Large-Scale Trial

Significant improvement in all basic swimming skill components ($p < 0.05$), with a total effect size of $r = 0.74$, indicates that the LRBKD Model has an impact that is not only statistically meaningful but also substantially practical. The largest increase in the breathing technique component (+41.7%; $r = 0.72$) is consistent with the model's hierarchical design that places breathing technique mastery as a prerequisite and main foundation before moving to other technical components (Neiva et al., 2014; Silva et al., 2019). This finding strengthens argument that fundamental movement skills mastery — in the context of swimming, breathing technique is the equivalent of fundamental movement patterns — must be prioritized before transitioning to the specialized movement phase (Boudebza, 2021; Libertus, 2020; Razaq et al., 2024).

The overall effect size ($r = 0.74$) is slightly higher than the meta-analysis report by Kim (2023) on structured 8–12 week swimming programs for beginner athletes ($r = 0.50$–0.70). Several factors can likely explain this difference. First, the integration of the task-based learning approach that is responsive to individual differences — where each module provides drill variations with different difficulty levels that can be selected according to athletes' actual abilities — enables each athlete to train in their zone of proximal development, which theoretically optimizes skill acquisition rates (Chow et al., 2021; Sheaff, 2023). Second, revision based on validator feedback that produced clearer and more operational instructions likely increased implementation fidelity by coaches, which in turn increased the consistency and quality of training stimulation received by athletes.

The practicality test result of 84.2% confirms that the model can be realistically implemented by swimming coaches in actual field conditions, without requiring additional resources not available in most swimming clubs in Indonesia. Ginting et al. (2025) emphasize that accessibility and ease of implementation are critical factors in the long-term adoption of training models at the club level; models that are theoretically superior but difficult for coaches to implement in the field will have little real impact on athlete development.

Theoretical and Practical Contributions

Theoretically, this research confirms that the integration of the task-based learning approach with training periodization based on motor development stages — which has been more widely studied in team sports (soccer, basketball) — can be effectively applied in individual aquatic sports contexts such as swimming, even for the 8–12 year age group (Dingley et al., 2015; Schaeffer, 2024). Methodologically, this research demonstrates that CVR validation procedures can be practically operationalized in sports training model development research in Indonesia (Baghestani et al., 2017; Solikhin et al., 2023) and provides significant added value compared to conventional validation procedures. In practice, the resulting LRBKD Model can be directly adopted by swimming coaches throughout Indonesia as a standardized guide for beginner athlete development (Endrawan et al., 2023; Ginting et al., 2025), while also serving as a reference for researchers seeking to develop similar models for other aquatic sports branches.

Non-Technical Determinants Beyond the Training Model

Although the LRBKD Model demonstrated significant improvement in technical skill outcomes, several non-technical variables that potentially moderate skill acquisition in beginner athletes aged 8–12 years were not directly examined in this study and deserve explicit acknowledgment. Athlete motivation — particularly intrinsic motivation tied to enjoyment, perceived competence, and autonomy in the aquatic environment — is consistently reported as a strong predictor of training adherence and long-term skill retention in young athletes; the task-based learning structure embedded in the LRBKD Model is theoretically aligned with these motivational principles, but motivation itself was not measured as a dependent variable. Parental support, including practical involvement (transportation, commitment to training fees, attendance at training sessions) and psychological support (encouragement, realistic expectations, emotional climate at home), also plays a substantial role during the 8–12 year age phase. The relatively high attendance rate observed in the large-scale trial (94.7%) likely reflects, at least partially, robust parental engagement that was not formally captured. Finally, coach quality — encompassing certification level, pedagogical experience, and fidelity of model implementation — is a critical mediator between any standardized training model and the actual stimulation athletes receive. In contrast, the implementing coaches in this study were highly qualified; variability in coach quality across the broader Indonesian context could substantially affect generalizability. These three variables are therefore positioned as priority moderating constructs to be explicitly modeled in subsequent research using the LRBKD Model.

Limitations of Study

Several limitations of this research need to be noted. First, the limited scope of subjects to four clubs in Surabaya City limits the generalization of results to contexts that differ geographically, culturally, and in facility quality. Second, the research design lacked a control group, so the contribution of maturation factors and natural training experience to skill improvement could not be fully controlled. Third, the absence of follow-up duration in this research makes long-term skill retention unmeasurable. Fourth, the number of validators (n=4) is the minimum number recommended for CVR; using more validators would increase the stability and confidence of the resulting CVR values. Further research is recommended to address these limitations by applying controlled experimental designs, expanding geographic and demographic subject coverage, and adding follow-up measurements to assess skill retention.

Conclusions

This research successfully developed and validated the LRBKD Model (Basic Skill-Based Swimming Training) through a systematic ADDIE-based R&D procedure, comprising field-based needs analysis, initial draft compilation, expert content validation using CVR by four active swimming coaching experts, revision based on validator feedback, small-scale trial, and large-scale trial. The findings demonstrate that the LRBKD Model meets the criteria for strong content validity, confirming that the model is appropriately designed to address the basic skill development needs of beginner athletes aged 8–12 years. The model was also found to be highly practical for coaches to implement in real field conditions and to significantly improve all four basic swimming skill components in beginner athletes, addressing the core research objectives of this study.

The implications of these findings are both practical and scientific. Practically, the LRBKD Model — consisting of eight progressive modules in a sixteen-week cycle — is feasible for widespread adoption by swimming coaches, sport-science students, and beginner athlete trainers in Indonesia. It is recommended that the model be disseminated to the national swimming coaching community through structured training and a user guide publication, serving as an evidence-based, standardized reference for early-age athlete development. Scientifically, this study contributes a replicable CVR-based content-validation procedure that other R&D studies in the development of sport-training models can adapt. Further research is recommended to test the model with a controlled experimental design including a comparison group, expand the geographic and cultural coverage of the subjects, integrate non-technical determinants such as athlete motivation, parental support, and coach quality into future evaluations, and include long-term follow-up to measure skill retention.

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Authors' contributions

MM and HA contributed to the research concept and design, collection and/or assembly of data, writing the article, and final approval of the article. KU contributed to the data analysis and interpretation, writing the article, and final approval of the article. IBE contributed to the data analysis and interpretation, critical revision of the article, and final approval of the article. MR contributed to the data analysis and interpretation, writing the article, and final approval of the article.

Competing interests

The authors declare no competing interests.

AI Disclosure Statement

During the preparation of this manuscript, the authors did not use any AI-based writing assistance tools. All content was written, reviewed, and approved by the authors, who take full responsibility for the integrity and accuracy of this manuscript.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author, M.M. The data are not publicly available due to restrictions containing information that could compromise the privacy of research participants.

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