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Integrating Skill Development and Water Confidence in Freestyle Swimming: An Application-Based Training Model

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Abstract

This study aimed to develop and evaluate an application-based training model that integrates technical skill development and water confidence in freestyle swimming. A research and development approach was employed using the ADDIE framework, encompassing analysis, design, development, implementation, and evaluation stages. The developed model was implemented through a mobile application featuring progressive freestyle swimming drills, visual demonstrations, and confidence-oriented learning activities. Participants consisted of 20 freestyle swimmers selected through simple random sampling. Model validity was examined through expert review using Aiken's V coefficient, while practicality was assessed based on responses from coaches and swimmers. Effectiveness was evaluated using a pretest–posttest design and analyzed with nonparametric statistics. The results indicated high content validity and practicality of the training model. Significant improvements were observed in overall freestyle swimming skills following implementation, with notable gains in breathing coordination, arm-leg coordination, and movement efficiency. Improvements in observable confidence-related behaviors, such as more relaxed breathing patterns and stable body alignment, were also identified. These findings suggest that integrating skill-oriented drills with confidence-enhancing strategies within an application-based framework can effectively support motor learning in aquatic environments. In conclusion, the proposed training model offers a theoretically grounded and practically feasible approach to improving freestyle swimming skills and water confidence. The integration of digital technology, motor learning principles, and confidence-oriented pedagogy provides a valuable contribution to swimming education and coaching practice.

Keyword: Application-based; freestyle swimming; motor skill development; swimming pedagogy water confidence

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Introduction

Swimming is widely recognized as a foundational aquatic sport that contributes to physical fitness, health, and competitive achievement across age groups. Among the competitive strokes, freestyle remains the fastest and most frequently contested, making it a core focus in swimmer development programs. Because of its central role in performance, mastery of freestyle requires not only physical conditioning but also precise movement control and readiness to perform confidently in the water (Dobra et al., 2025; McGibbon et al., 2018). Mastery of freestyle swimming is not merely determined by physical capacity but is strongly influenced by the swimmer's technical skills and psychological readiness, particularly confidence in water-based movement (Alkasasbeh et al., 2024; Seifert et al., 2014).

Freestyle swimming performance depends on the effective integration of body position, arm propulsion, flutter kick, breathing coordination, and stroke rhythm. Technical errors in these components can increase hydrodynamic drag, interrupt propulsion, and reduce efficiency, particularly among beginner and intermediate swimmers (Lumban, & Maidarman, 2019; Zamparo et al., 2020). These technical challenges are closely linked with psychological readiness, because swimmers with low water confidence often show rigid posture, excessive head lifting during breathing, and unstable coordination, all of which hinder motor learning in aquatic settings (Bíró et al., 2015; Schmidt et al., 2019; Seifert et al., 2014).

In practice, swimming instruction is still often dominated by repetitive drills, coach experience, and limited feedback, with insufficient attention to the simultaneous development of technical skill and confidence in water. At the same time, advances in digital technology offer important opportunities for more structured and engaging training through visual demonstration, drill sequencing, and accessible feedback. Recent studies have reported the potential of mobile-assisted learning, wearable feedback, and digital support tools in swimming; however, these studies tend to address motivation, biomechanical monitoring, or dry-land conditioning separately rather than integrating in-water technical development and confidence enhancement within one pedagogically coherent model (Alkasasbeh et al., 2024; Amaro et al., 2017; Fone & Van den Tillaar, 2022; Morais et al., 2022).

Several recent previous studies have shown that technology-assisted swimming training has developed in several important directions, but its integration is still limited. Alkasasbeh et al. (2024) found that mobile-assisted swimming applications can reduce fear of water and support the learning experience, yet the intervention was not designed as a structured freestyle technique program. (Morais et al., 2022) further showed through a systematic review that most swimming wearables are used to provide real-time biomechanical or kinematic feedback, with emphasis on measurement accuracy and performance monitoring. Likewise, (Dobra et al., 2025) demonstrated the potential of embedded devices for live stroke correction, but the technological focus remained centered on feedback delivery rather than on a pedagogically integrated training model.

These advances are valuable; however, they still tend to position technology as a motivational, monitoring, or corrective aid, not as a learning system that deliberately combines progressive freestyle drills, visual guidance, and confidence-building activities in one framework. Therefore, the novelty of the present study lies in the development of an

application-based training model that integrates technical skill progression and self-confidence enhancement within a single pedagogically grounded system, supported by motor learning principles and designed for direct use by coaches and swimmers (Farrow & Robertson, 2017; Light, 2014).

Accordingly, the present study is positioned not only to produce a digital training medium, but also to test a pedagogically structured model that can be implemented by coaches and swimmers in routine practice. Therefore, this study aims to develop and evaluate an app-based training model that integrates the development of technical skills and self-confidence in freestyle swimming.

Method

This study employed a research and development (R&D) approach using the ADDIE instructional design model as the main framework. ADDIE was selected because it provides a systematic and iterative procedure for developing, validating, implementing, and evaluating training products in skill-based contexts. In the implementation stage, the study also used a one-group pretest-posttest design to examine changes in freestyle swimming skills and swimming self-confidence after the application-based model had been used in routine training. The main outcomes of the study were the validity, practicality, and effectiveness of the developed product.

The participants were recruited from aquatic swimming club (ASC), Bekasi, Indonesia. The field trial involved 20 competitive swimmers selected through simple random sampling from the club's active swimmer roster. Based on baseline profiling, the participants were aged 10-12 years, consisting of 12 male and 8 female swimmers, and regularly trained three times per week. All participants had basic proficiency in freestyle swimming but still demonstrated technical inconsistencies and varying levels of confidence in water-based movement. Before data collection, all participants received an explanation of the procedures, and written informed consent was obtained from participants and parents or guardians for minors. The development of the training model followed the five stages of the ADDIE framework in an operational manner, as described below:

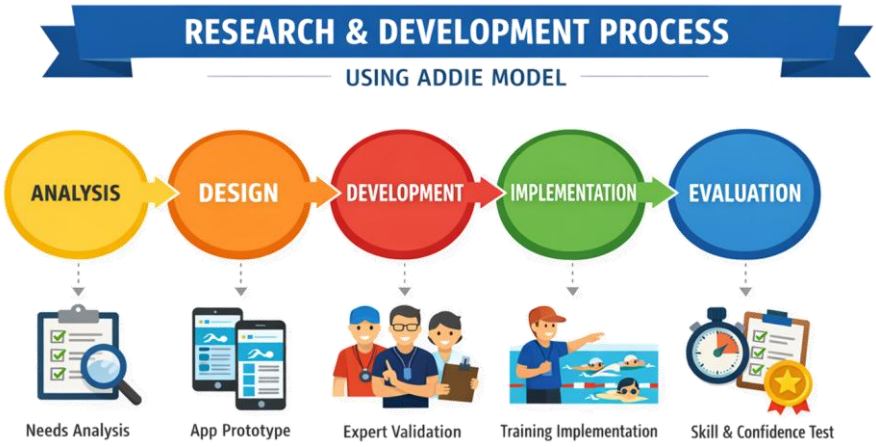

Figure 1. Research Model ADDIE

The analysis stage aimed to identify training needs and existing problems in freestyle swimming practice. Data were collected through field observations, informal interviews with swimming coaches, and a review of relevant literature. The analysis revealed that training sessions were predominantly conventional, lacked structured skill progression, provided limited visual feedback, and did not explicitly address swimmers' confidence in water. These findings formed the basis for developing a structured, confidence-oriented, and technology-supported training model. During the design stage, a conceptual framework for the application-based training model was developed. The model emphasized:

- Progressive freestyle swimming skill drills (arm movement, leg kicks, breathing coordination, and body alignment),
- Confidence-building components such as controlled breathing, body balance, and gradual coordination tasks,
- Integration of visual demonstrations, structured drill sequences, and feedback mechanisms.

A storyboard and navigation flow were designed to ensure the application was user-friendly, visually clear, and pedagogically coherent. At this stage, the design framework was transformed into a functional mobile-based application. The prototype included instructional videos, drill descriptions, training progressions, confidence-building tasks, and performance monitoring menus. The initial product was then submitted to two swimming experts and one media expert for review of content accuracy, instructional sequence, interface clarity, and usability. Suggestions from these experts were used to revise the wording of instructions, improve drill sequencing, and refine the visual display before the product was tried out in the field.

The revised application was implemented in regular training sessions over 12 meetings. During this phase, swimmers used the application as a structured practice guide, while coaches facilitated drill execution and monitored performance. The implementation stage employed a one-group pretest-posttest format in which freestyle swimming skill scores and self-confidence scores were collected before and after the intervention. Evaluation was carried out through both formative and summative procedures. Formative evaluation took place during development and limited implementation, especially through expert comments and user feedback used for product revision. Summative evaluation was conducted after the field trial to determine the overall validity, practicality, and effectiveness of the application-based training model.

Freestyle swimming skills were assessed using a performance-based observation rubric, covering four key components Start technique, Arm movement, Leg movement (flutter kick), Breathing coordination. Each component was rated on a four-point scale (1 = poor to 4 = very good). The rubric emphasized technical accuracy, coordination, and movement efficiency, making it appropriate for assessing skill acquisition rather than performance time only. Before use, the observation sheet was reviewed by content experts to ensure alignment between indicators and the targeted freestyle movements.

Self-confidence in freestyle swimming was assessed using a modified Self-Efficacy in Swimming Scale adapted from (Šamija et al., 2016). The original instrument was developed specifically to assess swimmers' self-efficacy and consisted of 34 items rated on a five-point Likert scale. In the present study, the instrument was adapted to fit the context of freestyle swimming training and to emphasize confidence-related aspects relevant to learning

performance, particularly breathing control, body alignment, movement coordination, task persistence, and readiness to perform drills in water. The modified version consisted of 10 items scored on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.

Higher scores indicated higher self-confidence in freestyle swimming practice. Prior to implementation, the adapted items were reviewed by experts in swimming pedagogy and sport measurement to ensure content relevance and clarity. Internal consistency reliability of the modified scale was then examined using Cronbach's alpha. The adaptation process focused on preserving the original construct of swimming self-efficacy while aligning the wording with the instructional context of freestyle skill training. Data analysis was conducted in several stages. Content validity of the developed training model and instruments was examined using Aiken's V coefficient based on expert judgment.

Practicality data obtained from coaches and swimmers were analyzed descriptively using percentage scores and then interpreted into qualitative categories. Before testing the effectiveness of the model, the distribution of pretest and posttest scores was examined using the Shapiro–Wilk normality test, because the sample size was relatively small (n = 20). The results of the normality test indicated that the data were not normally distributed and the measurement scores were treated as ordinal performance data derived from rating-scale observations. Therefore, a nonparametric statistical approach was considered more appropriate. To evaluate the effectiveness of the application-based training model, differences between pretest and posttest scores on freestyle swimming skills and self-confidence were analyzed using the Wilcoxon signed-rank test. This test was selected because it is appropriate for comparing two related measurements obtained from the same participants when the assumptions of parametric testing are not met. In addition to statistical significance, effect size (r) was calculated to determine the magnitude of the intervention effect.

Result

The results of this study are presented in six main parts expert validation of the application-based freestyle swimming training model, instrument reliability, practicality evaluation based on coach and swimmer responses, normality testing, effectiveness of the model in improving freestyle swimming skills, and changes in swimmers' self-confidence after implementation of the training model. Expert validation was conducted to examine the content validity and media feasibility of the developed training model. Two swimming experts evaluated the instructional content and technical accuracy of the freestyle swimming drills, while one media expert assessed the application's design, navigation, and usability. Content validity was analyzed using Aiken's V coefficient.

Table 1. Expert validation results (Aiken's V)

Aspect Evaluated	Number of Items	Aiken's V	Interpretation
Training content relevance	6	0.89	Very valid
Technical accuracy of freestyle drills	6	0.91	Very valid
Integration of skill and confidence elements	5	0.87	Very valid

Instructional clarity and sequence	4	0.88	Very valid
Application design and navigation	13	0.90	Very valid
Overall validity	34	0.89	Very valid

The Aiken's V coefficients for all evaluated aspects ranged from 0.87 to 0.91, indicating a high level of agreement among experts. These results demonstrate that the developed model and application content were considered valid, accurate, and appropriate for freestyle swimming training. Internal consistency reliability was examined before the effectiveness analysis was interpreted. Cronbach's alpha was calculated for the freestyle swimming observation sheet and the modified self-confidence scale. As presented in table 2, both instruments demonstrated acceptable internal consistency and were therefore considered suitable for use in the field trial.

Table 2. Reliability coefficients of the research instruments

Instrument	Number of Item	Cronbach's Alpha	Interprestation
Freestyle swimming observation sheet	4	0.86	Reliable
Modified self-confidence scale	10	0.88	Reliabel

These reliability findings strengthen the credibility of the subsequent validity and effectiveness analyses because the scores were generated from instruments with stable internal consistency. Practicality was evaluated through questionnaires completed by coaches and swimmers after the implementation phase. The assessment focused on ease of use, clarity of instructions, suitability of training content, and perceived usefulness in training sessions.

Table 3. Practicality evaluation by coaches and swimmers

Aspect	Mean Percentage (%)	Category
Ease of application use	88.5	Very practical
Clarity of training instructions	86.2	Very practical
Suitability for freestyle skill training	90.1	Very practical
Support for swimmer confidence	84.7	Very practical
Overall practicality	87.4	Very practical

The overall practicality score of 87.4% indicates that the application-based training model was perceived as very practical by users. Coaches reported that the application helped structure training sessions more systematically, while swimmers indicated that visual demonstrations and progressive drills increased their understanding and confidence during practice. Before testing the effectiveness of the intervention, the distribution of the pretest and posttest total scores was examined using the Shapiro-Wilk test. The results in table 4 indicate that the assumption of normality was not met, and the technical performance scores were also derived from an ordinal rubric. Therefore, the Wilcoxon signed-rank test was considered the more appropriate procedure for analyzing two related measurements in this study.

Table 4. Shapiro-wilk normality test results

Variable	Pretest W	p-value	Posttest W	p-value	Interprestation
Freestyle swimming skills	0.887	0.024	0.901	0.041	Non-normal
Self-confidence	0.893	0.031	0.912	0.067	Non-normal

The effectiveness of the training model was first examined by comparing swimmers' freestyle swimming skill performance before and after the intervention. Table 5 presents descriptive changes in four technical components and the overall skill score, while Table 6 summarizes the Wilcoxon signed-rank test results and effect sizes.

Table 5. Descriptive statistics of freestyle swimming skill scores

Skill Component	Pretest Mean (SD)	Posttest Mean (SD)	Mean Difference
Start technique	2.45 (0.51)	3.35 (0.49)	+0.90
Arm movement	2.60 (0.50)	3.50 (0.51)	+0.90
Leg movement	2.40 (0.60)	3.30 (0.57)	+0.90
Breathing coordination	2.30 (0.65)	3.40 (0.50)	+1.10
Overall skill score	2.44 (0.42)	3.39 (0.38)	+0.95

The descriptive results show consistent improvements across all skill components following the implementation of the application-based training model. The largest improvement was observed in breathing coordination, indicating that the intervention most strongly supported respiratory control and stroke continuity.

Table 6. Wilcoxon signed-rank test result and effect sizes

Variable	Z	p-value	Effect size (r)	Magnitude	Interprestation
Freestyle swimming skills	-3.92	<0.001	0.62	Large	Significant improvement
Self-confidence	-3.74	<0.001	0.59	Moderate to Large	Significant improvement

Based on the Wilcoxon Signed-Rank Test results, there was a highly significant difference in scores between the pretest and posttest for freestyle swimming skills ($Z = -3.92$, $p < 0.001$, $r = 0.62$) and self-confidence ($Z = -3.74$, $p < 0.001$, $r = 0.59$). The effect size value of $r = 0.62$ for skills indicates a large effect according to Cohen's criteria (0.5 = medium, 0.8 = large), which means this app-based intervention has a substantial practical impact beyond mere statistical significance. This large effect is consistent with the mean difference of +0.95 points seen in Table 5, indicating that the improvement in skills is not a chance effect but rather the result of the progressive drill structure. Self-confidence was analyzed separately using the modified Self-Efficacy in Swimming Scale so that confidence-related changes were not inferred only from observation. Table 7 presents the overall pretest and posttest self-confidence scores of the swimmers after participation in the intervention, while the inferential result is summarized in Table 6.

Table 7. Descriptive statistics of self-confidence scores

Variable	Pretest Mean (SD)	Posttest Mean (SD)	Mean Difference
Overall Self-Confidence Score	32.45 (4.82)	39.20 (4.15)	+6.75

The analysis results showed a significant and substantial increase in self-confidence after the implementation of the application-based training model table 7. Self-confidence scores increased from an average of 32.45 (SD=4.82) in the pretest to 39.20 (SD=4.15) in the posttest, with an average difference of +6.75 points (equivalent to an increase of 0.67 points per Likert item). This increase indicates that participants not only mastered freestyle techniques mechanically but also experienced increased self-efficacy in performing movements in the water.

Discussion

The findings of this study demonstrate that the application-based freestyle swimming training model is valid, practical, and effective in improving swimmers' technical skills, with pronounced improvements in breathing coordination and overall movement efficiency. These outcomes reinforce the argument that skill acquisition in swimming is not solely a biomechanical process but a complex interaction between motor learning mechanisms and psychological readiness, particularly confidence in aquatic environments. The effectiveness of the application-based training model can be interpreted primarily from a motor learning perspective. The program organized freestyle practice progressively, beginning with fundamental tasks such as breathing control, body alignment, and isolated coordination, before moving to more integrated stroke execution.

Such sequencing likely reduced task complexity and allowed swimmers to stabilize essential movement patterns before performing the complete skill. This interpretation is consistent with motor learning principles that emphasize structured progression, task specificity, repetition, and feedback as key conditions for efficient skill acquisition (Haibach-Beach et al., 2023; Williams & Hodges, 2023). Therefore, the gains observed in start technique, arm movement, leg movement, and overall freestyle performance indicate that swimmers benefited not only from repeated practice, but from better organized practice. The contribution of the application should also be understood as pedagogical rather than merely technological.

Instead of functioning only as a medium for presenting information, the application served as an instructional scaffold through visual demonstrations, drill sequencing, and consistent training cues. This likely helped coaches standardize practice sessions and enabled swimmers to understand what movement should be performed, how it should be executed, and in what order it should be practiced. In aquatic learning, where swimmers cannot easily observe their own movement patterns while performing, this kind of structured visual support is particularly valuable. The high practicality scores reported in this study support the view that technology can contribute meaningfully when it improves clarity, feedback, and learning organization in training contexts (Alamri, 2021; Renshaw et al., 2022).

Breathing coordination deserves special attention because it is not only a technical component of freestyle swimming but also an important behavioral indicator of self-confidence

in water. In practice, swimmers who are still tense or uncertain often lift the head excessively, interrupt body alignment, and lose movement rhythm when attempting to inhale. By contrast, more relaxed and synchronized breathing suggests greater control, comfort, and trust in one's ability to remain stable in the aquatic environment. The marked improvement in breathing coordination found in this study therefore indicates more than technical refinement; it also suggests that the confidence-oriented elements of the model helped swimmers become more psychologically ready to perform the skill.

This interpretation is consistent with previous work showing that confidence in aquatic settings supports relaxation, balance, and movement continuity during practice (Coelho et al., 2025; Sumartana & Setiaji, 2025; Tomescu et al., 2025). The integration of technology within the training model further contributed to these outcomes. Recent research on technology-assisted coaching emphasizes that digital tools are most effective when they support pedagogical structure rather than merely providing performance data (Alamri, 2021; Farrow & Robertson, 2017). Unlike wearable-based systems that primarily deliver quantitative feedback, the application developed in this study functioned as an instructional scaffold, guiding swimmers through learning stages while reinforcing confidence through predictable routines and visual clarity.

This aligns with self-determination theory, which posits that structured guidance and perceived competence enhance intrinsic motivation and engagement (Ryan & Deci, 2020). The high practicality ratings reported by coaches and swimmers indicate that the model was not only effective but also feasible for real-world training contexts. This is particularly important given recent concerns that technologically advanced training systems may be underutilized due to complexity or poor alignment with coaching practices. The findings suggest that application-based models, when designed with pedagogical simplicity and usability in mind, can bridge the gap between scientific knowledge and daily coaching routines.

This supports recent calls for coach-centered technology integration that enhances, rather than replaces, instructional decision-making (Kessler, 2018). Theoretically, the findings support the view that technical skill development and self-confidence should be treated as mutually reinforcing components in swimming instruction rather than as separate outcomes. The study extends the application of motor learning principles by showing that confidence-building elements can be embedded directly into drill design and supported through digital media. Practically, the model offers coaches a feasible way to structure freestyle training more systematically, especially for beginner and intermediate swimmers who need clear demonstrations, gradual progression, and repeated opportunities to refine coordination.

The application can therefore be used not only as a learning aid for swimmers, but also as a guide for coaches in organizing practice sequences and delivering more consistent feedback. This study has several limitations. The sample was relatively small and drawn from a single training context, which may limit the generalizability of the findings. In addition, self-confidence was assessed using an adapted instrument and supported by performance-related indicators, so the psychological interpretation of improvement should be considered cautiously. Future studies are recommended to use larger samples, experimental designs with control groups, and more standardized psychometric instruments to examine the relationship between

technical improvement and self-confidence more rigorously. Longer follow-up periods are also needed to determine whether the observed gains are maintained over time.

Conclusion

This study developed and evaluated an application-based training model for freestyle swimming that integrates technical skill development and self-confidence enhancement. The findings indicate that the model is valid, as reflected in expert judgment; practical, as shown by positive responses from coaches and swimmers; and effective, as demonstrated by improvements in freestyle swimming performance, particularly in breathing coordination, arm-leg coordination, and overall movement efficiency. The main contribution of this study lies in its integration of digital technology, motor learning principles, and confidence-oriented training within a single pedagogically structured model. Practically, the application can serve as a feasible instructional tool for coaches and swimmers to support more systematic, engaging, and confidence-supportive freestyle training in regular practice settings. Future research is recommended to employ an experimental design with a control group, involve larger and more diverse samples, and use standardized psychometric instruments to measure self-confidence more rigorously. Further studies are also needed to examine the long-term effects of the model across different age groups, levels of swimming proficiency, and broader training contexts.

Author Statement

The author states that this article has not been previously published elsewhere and is not under consideration for other publications. All references cited in the text have been formatted according to the standard reference style. The author is fully responsible for the content of this article. The author also expresses thanks to the club and the participants who kindly contributed to this research. This can support the success of the implementation in refining this manuscript.

References

Alamri, H. A. (2021). Learning Technology Models that Support Personalization within Blended Learning Environments in Higher Education. *TechTrends*, *65*(1), 62–78. https://doi.org/10.1007/s11528-020-00530-3

Alkasasbeh, W. J., Alawamleh, T., Aloran, H., Farash, T., & Orhan, B. E. (2024). The Impact of Mobile-Assisted Swimming Applications on Intrinsic Motivation and Fear Reduction in Aquatic Environments Among Students in the Swimming Course. *Front. Sports Act. Living*, *6*(1496733), 1–9. https://doi.org/10.3389/fspor.2024.1496733

Amaro, N. M., Marinho, D. A., Marques, M. C., Batalha, N. P., & Morouço, P. G. (2017). Effects of Dry-Land Strength and Conditioning Programs in Age Group Swimmers. *Journal of Strength and Conditioning Research*, *31*(9), 2447–2454. https://doi.org/10.1519/JSC.0000000000001709

Bíró, M., Revesz, L., & Péter, H. (2015). *Swimming: History, Technique, Teaching*. EKC Líceum Press. http://oszkdk.oszk.hu/beszolgaltatas/index.php

Coelho, D., Eira, P., & Azevedo, A. (2025). Fear of the Aquatic Environment in Learning

Swimming: Causes, Effects, and Learning Methodologies. In *Education Sciences* 15(6). pp. 760). https://doi.org/10.3390/educsci15060760

Dobra, V.-A., Dobra, I.-M., Folea, S., & Sabau, R. (2025). Real-Time Feedback in Swimming Exercises Using Embedded Devices in Water. In *Applied Sciences* 15(12). pp. 6771. https://doi.org/10.3390/app15126771

Farrow, D., & Robertson, S. (2017). Development of a Skill Acquisition Periodisation Framework for High-Performance Sport. *Sports Medicine*, *47*(6), 1043–1054. https://doi.org/10.1007/s40279-016-0646-2

Fone, L., & Van den Tillaar, R. (2022). Effect of Different Types of Strength Training on Swimming Performance in Competitive Swimmers: A Systematic Review. *Sports Medicine - Open*, *8*(1), 19. https://doi.org/10.1186/s40798-022-00410-5

Haibach-Beach, P. S., Perreault, M., Brian, A., & Collier, D. H. (2023). *Motor Learning and Development* (Third Edit). Human kinetics.

Kessler, G. (2018). Technology and the Future of Language Teaching. *Foreign Language Annals*, *51*(1), 205–218. https://doi.org/10.1111/flan.12318

Light, R. (2014). Learner-Centred Pedagogy for Swim Coaching: a Complex Learning Theory-Informed Approach. *Asia-Pacific Journal of Health, Sport and Physical Education*, *5*(2), 167–180. https://doi.org/10.1080/18377122.2014.906056

Lumban, S. D. P. & Maidarman, M. (2019). Analisis Teknik Gerak Renang Gaya Bebas. *Jurnal Patriot*, *1*(2), 799-809. http://patriot.ppj.unp.ac.id/index.php/patriot/article/view/372

McGibbon, K. E., Pyne, D. B., Shephard, M. E., & Thompson, K. G. (2018). Pacing in Swimming: A Systematic Review. *Sports Medicine (Auckland, N.Z.)*, *48*(7), 1621–1633. https://doi.org/10.1007/s40279-018-0901-9

Morais, J. E., Oliveira, J. P., Sampaio, T., & Barbosa, T. M. (2022). Wearables in Swimming for Real-Time Feedback: A Systematic Review. In *Sensors* 22(10), pp. 3677. https://doi.org/10.3390/s22103677

Renshaw, I., Davids, K., & Sullivan, M. (2022). Learning and Performing: what Can Theory Offer High Performance Sports Practitioners? *Brazilian Journal of Motor Behavior*, *16*(2), 162–178. https://doi.org/10.20338/bjmb.v16i2.280

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and Extrinsic Motivation From a Self-Determination theory Perspective: Definitions, Theory, Practices, and Future Directions. *Contemporary Educational Psychology*, *61*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Schmidt, R. A., Lee, T. D., Winstein, C. J., Wulf, G., & Zelaznik, H. N. (2019). *Motor Control and Learning: A Behavioral Emphasis*. Human Kinetics.

Šamija, I., Sporiš, G., & Šamija, K. (2016). Self-efficacy Scale Construction and Validation in Swimming. *Acta Kinesiologica*, *10*(1), 33-37.

Seifert, L., Komar, J., Barbosa, T., Toussaint, H., Millet, G., & Davids, K. (2014). Coordination Pattern Variability Provides Functional Adaptations to Constraints in Swimming Performance. *Sports Medicine (Auckland, N.Z.)*, *44*(10), 1333–1345. https://doi.org/10.1007/s40279-014-0210-x

Sumartana, I. M., & Setiaji, Y. (2025). The Physical and Mental Health Benefits of Swimming : Enhancing Fitness, Relaxation, Endurance, and Overall Well-Being. *Journal of*

Interdisciplinary and Multidisciplinary Studies, *1*(2), 88–100.

Tomescu, G., Bălan, V., Aivaz, K.-A., & Zahiu, M. (2025). The Benefits of Practicing Physical Activity in the Aquatic Environment on Health and Quality of Life. In *Healthcare* 13(9) pp. 1053). https://doi.org/10.3390/healthcare13091053

Williams, A. M., & Hodges, N. J. (2023). Effective Practice and Instruction: A Skill Acquisition Framework for Excellence. *Journal of Sports Sciences*, *41*(9), 833–849. https://doi.org/10.1080/02640414.2023.2240630

Zamparo, P., Cortesi, M., & Gatta, G. (2020). The Energy Cost of Swimming and its Determinants. *European Journal of Applied Physiology*, *120*(1), 41–66. https://doi.org/10.1007/s00421-019-04270-y