Validation of the Swimming Competence Questionnaire for Children

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Abstract

Two studies were employed to test the reliability and validity of the Swimming Competence Questionnaire (SCQ) among primary school children. Study 1 was a cross-sectional survey in 4959 primary school children. Study 2 was a pre-post-test quasi-experiment among 1609 primary school children who underwent a 20-lesson learn-to-swim program. In Study 1, exploratory structural equation modeling revealed excellent goodness-of-fit and scale reliability for a two-factor model comprising distance and skill factors, which supported the construct and convergent validity. SCQ scores were significantly and positively correlated with swimming outcomes (i.e., self-efficacy, intention, swimming frequency), which supported SCQ's concurrent and criterion validity. Average variance extracted for the SCQ factors exceeded cutoff criteria supporting discriminant validity. In Study 2, pre-test SCQ scores correlated significantly and positively with the SCQ scores, self-efficacy, intention, and swimming frequency at post-test, which supported SCQ's test-retest reliability and predictive validity. Positive intraclass correlation between SCQ scores and coach ratings at post-test provided evidence for SCQ's inter-rater reliability. SCQ scores significantly improved at post-test, which supported SCQ's ecological validity. In conclusion, findings indicate that the SCQ is a valid and reliable measure to assess primary school children's swimming competence, in terms of swimming distance and basic water survival skills.

Keywords: Psychometric tool; self-efficacy; sport competence; water safety; validity.

Validation of the Swimming Competence Questionnaire for Children

Swimming is not only a competitive sport for elite athletes, it is also one of the most popular types of exercise that confers health benefits (Chase, Sui, & Blair, 2008; Oja et al., 2015), including improvements in cardiovascular health, fitness, and body composition (Lahart & Metsios, 2018; Tanaka, 2009), better muscular strength (Carrasco & Vaquero, 2012), better blood lipid profiles and fasting blood glucose, and lower risk of hypercholesterolemia (Chase et al., 2008). Swimming is also a fundamental survival skill. For example, prior research has demonstrated associations between swimming competence, swimming lessons, and drowning (Brenner, Saluja, & Smith, 2003; World Health Organization, 2014); children who participated in formal swimming lessons or with good swimming competence were less likely to experience drowning than children who did not (Brenner et al., 2003; Brenner et al., 2009). Investigations on the relationship between swimming and individuals' health and safety are dependent on the quality of measures to assess swimming competence. To date, however, limited research has been conducted to test the reliability and validity of swimming competence measures, especially among child populations (Brenner et al., 2003; Fife & Goldoft, 1994; Irwin, Irwin, Ryan, & Drayer, 2009; Leavy et al., 2015; Saluja et al., 2006; Tyler et al., 2017).

The *Swimming Scale* (Erbaugh, 1978) developed in the 1970s was the first validated assessment tool for swimming competence that received support for its convergent validity, inter-rater reliability, and test-retest reliability. The Swimming Scale was designed to evaluate preschool children's swimming competence (Erbaugh, 1978). To complete the scale, an experienced swimming instructor is required to judge and then rate a child's swimming skills in a range of swimming tasks (e.g., water entry, locomotion, breathing, kicking, diving, swimming through obstacles) (Erbaugh, 1978). Although the scale is able to provide a measure of swimming competence (Erbaugh, 1978), it has limitations including being labor-intensive, costly, and designed exclusively for preschool children. Given these limitations, researchers have tried to apply a variety of self-report methods that could be administered on a large scale and assess swimming competence across different age ranges (Fife & Goldoft, 1994; Gilchrist, Sacks, & Branche, 2000; Irwin et al., 2009).

Many of these measures, however, only used single items and simple definitions with few categories to differentiate individuals' swimming competence (e.g., "none" to "strong" (Fife & Goldoft, 1994), "unable to swim" to "could swim competitively" (Irwin et al., 2009), "non-swimmers" to "swimmers" (Langley & Silva, 1986), asking participants' swimming distance in terms of the lengths of standard pool without stopping or resting (Gilchrist et al., 2000; McCool, Moran, Ameratunga, & Robinson, 2008)). Such measures are unable to provide an assessment of swimming competence with any precision, and ignore many important swimming skills. The *Can You Swim* questionnaire (Moran et al., 2012) is a more comprehensive tool that evaluates six aspects of drowning-prevention-related swimming and survival skills (i.e., distance swim, flotation, swim on back, dive entry, surface dive, underwater swim). The measure is targeted at those with at least entry standard swimming competence (Moran et al., 2012); thus, the applicability of the scale to children or individuals with limited swimming competence is uncertain. Furthermore, similar to other self-reported measures of swimming competence (Fife & Goldoft, 1994; Gilchrist et al., 2000; Irwin et al., 2009; McCool et al., 2008), the Can You Swim questionnaire has not been fully evaluated for a range of validity and reliability evidence (Moran et al., 2012).

Currently, to the authors' knowledge, there is no comprehensive and reliable and valid measure for the assessment of swimming competence among children. To resolve this gap in knowledge, the *Swimming Competence Questionnaire* (SCQ; see Appendix A) was recently developed to provide a comprehensive assessment of children's swimming competence. The SCQ is a brief single page questionnaire that children can complete, with or without the assistance of adults. The questionnaire comprises five continuous items in which respondents are required to report their *swimming distance* in meters (i.e., maximum distance one can swim without assistance or rest) using a (1) *general swimming stroke* (any stroke or combination of swimming strokes) and specific strokes; namely, (2) *breaststroke*, (3) *front-crawl*, (4) *backstroke*, and (5) *butterfly*; as well as six dichotomous items where respondents are required to report whether or not they can complete basic *swimming skills*: (1) *swimming underwater*, (2) *holding breath underwater*, (3) *floating*, (4) *poolside kicking*, (5) *kickboard kicking,* and (6) *treading water*. To enhance understanding, items of the SCQ are accompanied by pictures of swimming strokes,

basic swimming skills, and a diagram of standard 25m/50m swimming pools to help estimate distance. The present article reports the findings of two studies that aimed to validate the SCQ among primary school children in Hong Kong.

Study 1

Study 1 was a large-scale cross-sectional survey. We aimed to examine the construct validity and factor structure, convergent validity, concurrent validity, criterion validity, and discriminant validity of the SCQ. Based on the structure and item content of the SCQ, we hypothesized the SCQ would load on two factors: s*wimming distance* and *swimming skills*, and the factor scores of the SCQ would exhibit evidence supporting convergent validity evidenced by Cronbach's alpha coefficients exceeding 0.70 for each factor. Prior research has demonstrated that children's ability or performance in sport was positively related to their swimming self-efficacy (i.e., perceived capacity or controllability of swimming) (Chase, 2001; Moritz, Feltz, Fahrbach, & Mack, 2000), intention to participate in swimming in future (Mummery & Wankel, 1999), and adherence (e.g., frequency of participation in swimming or attendance to swimming lessons or classes) (Babic et al., 2014). Therefore, we hypothesized that concurrent validity (i.e., SCQ constructs would be significantly and positively correlated with swimming self-efficacy), criterion validity (i.e., SCQ constructs would be significantly and positively correlated with swimming intention and frequency), and discriminant validity (i.e., SCQ constructs would be statistically independent from swimming self-efficacy, intention, and frequency) of SCQ would be supported.

Methods of Study 1

The Institutional Review Board of The University of Hong Kong (reference: UW-16407) approved the protocol of Study 1. Participants comprised 4,959 children from 28 primary schools across 15 districts in Hong Kong (M_{age} = 8.63 ± 1.71, range = 5 to 14; male = 45.06%). On average, participants started to learn swimming at the age of 6.12 years (*SD* = 1.77); and had 2.79 years (*SD* = 1.99) of swimming experience, swam 2.88 times (*SD* = 3.25) per month, and undertook 74.92 minutes (*SD* = 37.23) of swimming activity per session. Both participants and their parents/guardians provided

informed consent before completing the study questionnaire, and parents/guardians were encouraged to assist their child in filling out the questionnaire.

Measures. The study questionnaire comprised the SCQ, and measures of swimming self-efficacy, intention, and frequency. In the SCQ, responses to items assessing swimming distance were coded on a 6-point scale based on pre-defined distance categories: 0 = very weak 0m – 4.99m, 1 = weak 5m –12.49m, 2 = beginner 12.5m – 24.99m, 3 = intermediate 25m – 49.99m, 4 = good 50m – 99.99m, and 5 = excellent >100m; and swimming skills were coded: 0 = I can and 1 = I can't. The items assessing swimming self-efficacy (5 items; e.g., "It is easy for me to swim during the next month", scored 1 = strongly disagree and 7 = strongly agree), swimming intention (3 items; e.g., "I plan to swim during the next month", scored 1 = strongly disagree and 7 = strongly agree), and were adopted from Ajzen (2002). Swimming frequency was measured with 1 item (i.e., "how often do you go to swim?"), with responses converted into swimming times per month.

Data analysis. We examined the factor structure of the SCQ by exploratory structural equation modeling (Marsh, Morin, Parker, & Kaur, 2014; Marsh et al., 2009) with oblique geomin rotation, and robust weighted least squares estimation (WLSMV) using Mplus version 7.2 (Muthén & Muthén, 1998-2012). We used the conventional fit indices to assess the model fit, comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA). Traditional cut-off criteria for CFI and TLI (i.e., 0.90), and for RMSEA (i.e., 0.08) were applied to indicate acceptable fit (Hu & Bentler, 1999). Cronbach's alpha coefficients for the SCQ factors were computed for convergent validity. For concurrent and criterion validity, we estimated correlations among the SCQ constructs, *Swimming Competence Index* (SCI; a composite score of SCQ items that ranges from 0 "incompetent" to 100 "competent"; see Appendix A for the algorithm) with swimming self-efficacy, intention, and frequency in a confirmatory factor analysis (CFA) model. For discriminant validity, we estimated the shared variance between the factors and average variance extracted (AVE) for each factor. When the AVE exceeds the shared variance discriminant validity is supported (Hu & Bentler, 1999).

Results of Study 1

Exploratory structural equation modeling yielded a two-factor model with excellent goodness-of-fit (χ^2 = 1270.07 (df = 34), CFI = 0.99, TLI = 0.99, RMSEA = 0.09 [90% CI = 0.08 to 0.09]), high factor loadings on the proposed distance (mean loading = 0.92 ± 0.06) and skills (mean loading = 0.86 ± 0.12) factors, and low cross-loadings (mean cross-loadings = 0.02 ± 0.09). The CFA model also fitted the data very well (χ^2 = 2045.37 (df = 176), CFI = 0.99, TLI = 0.98, RMSEA = 0.05 [90% CI = 0.04 to 0.05]). For convergent validity, Cronbach alpha coefficients of the SCQ factors ranged from 0.84 to 0.94. For the concurrent and criterion validity, swimming distance, swimming skills, and SCI had moderate correlations with swimming self-efficacy (r = 0.36 to 0.38, $p < 0.01$), intention (r = 0.31 to 0.33, $p < 0.01$), and frequency (r = 0.39 to 0.73, $p < 0.01$). For discriminant validity, the AVEs of the SCQ variables (range: 0.76 to 0.87) were higher than their shared variance (range: 0.10 to 0.66). Table 1 displays the distributions and correlation matrix among the variables.

Summary of Study 1

In sum, findings from Study 1 supported the two-factor structure (i.e., *swimming distance* and *swimming skills*) of the SCQ. Convergent, concurrent, criterion, and discriminant validity of the SCQ were also supported.

[Insert Table 1 about here]

Study 2

Study 2 was a two-wave pre-post-test quasi-experimental study of a learn-to-swim program for junior primary school children. We hypothesized that the findings would support the test-retest reliability of the SCQ. Specifically, we expected SCQ constructs before (pre-test) and after (post-test) participating in the learn-to-swim program would be significantly and positively correlated. We also expected the SCQ to exhibit predictive validity such that the SCQ constructs at pre-test would be significantly and positively correlated with swimming self-efficacy, intention, and frequency at post-test. We also proposed that the SCQ would exhibit satisfactory inter-rater reliability; SCQ constructs

and instructor evaluation of swimming performance at post-test would be significantly and positively correlated. Finally, we predicted improvements in SCQ scores from pre-test to post-test, the ecological validity of the SCQ.

Methods of Study 2

Participants comprised 1,614 children (M_{age} = 6.40 ± 0.52, range = 5 to 9; male = 54.18%) who took part in a learn-to-swim program involving a maximum total of 20 free swimming lessons (1 hour per lesson). The students were local junior primary school students in Hong Kong who self-reported prior to participation in the study that they had limited swimming competence. The swimming lessons were divided into six progressive sections including warm-up, preparation, kicking, pulling, kicking-pulling drills, and technique correction (see Appendix B for the content of the curriculum), and were delivered by qualified swimming instructors. Participants were asked to complete the swimming lessons (on average 18.45 ± 3.17 lessons were completed) between February and July of 2017, and the questionnaire of Study 1 before and after the completion of the learn-to-swim program (mean program length = 3.26 ± 1.52 months). In addition to the self-reported questionnaire, data were obtained from swimming instructors who reported on the maximum swimming distance participants had achieved at the end of the learn-to-swim program. Study 2 adopted the same consent procedures and measures as in Study 1. Separate ethical approval was obtained from the Institutional Review Board as described in Study 1 (reference: UW-16478).

Data analysis. We examined factor correlations among the SCQ factors and other study variables (i.e., swimming self-efficacy, intention, and frequency) at pre-test and post-test to test the test-retest reliability and predictive validity of SCQ. For inter-rater reliability, we examined the intraclass correlation (ICC) between the SCQ variables and instructor evaluation (i.e., the coding of responses applied the same distance categories of SCQ), using two-way mixed effects model with absolute agreement definition. For the ecological validity, paired-samples *t*-test were used to examine if SCQ variables significantly and positively improved from pre-test to post-test.

Results of Study 2

The CFA model exhibited excellent fit (χ^2 = 1392.92 (df = 486), CFI = 0.99, TLI = 0.99, RMSEA = 0.04 [90% CI = 0.03 to 0.04]). For test-retest reliability, significant and positive correlations were observed between pre-test and post-test scores on the swimming distance (r = 0.76, p < 0.01), swimming skills (r = 0.59, p < 0.01), and SCI (r = 0.66, p < 0.01) factors. For predictive validity, SCQ variables at pre-test were significantly and positively associated with swimming self-efficacy ($r_{distance}$ = 0.18, r_{skills} = 0.14, r_{SCI} = 0.17, all p < 0.01), swimming intention ($r_{distance}$ = 0.16, r_{skills} = 0.14, r_{SCI} = 0.15, all p < 0.01), and swimming frequency ($r_{distance}$ = 0.18, r_{skills} = 0.19, r_{SCI} = 0.19, p < 0.01) at post-test. For inter-rater reliability, instructor evaluation significantly and positively correlated with swimming distance (ICC = 0.24 [95% CI = 0.07 to 0.37]) and SCI (ICC = 0.44 [95% CI = 0.09 to 0.63]), but not with swimming skills (ICC = 0.03 [95% CI = -0.07 to 0.12]). For the ecological validity, swimming distance (t(751) = -17.38, p < 0.01), swimming skills (t(842) = -24.06, p < 0.01), and SCI (t(783) = -23.54, p < 0.01) significantly and positively improved from pre-test to post-test.

Summary of Study 2

Findings of Study 2 supported the test-retest reliability, predictive validity, and ecological validity of the SCQ. Inter-rater reliability of the SCQ was largely supported through the positive associations between instructor evaluation and swimming distance and SCI, but the link between instructor evaluation and swimming skills was not significant.

Discussion

Swimming competence is one of the key factors that determines children's participation in swimming and other water-related sports (Barnett, Hinkley, Okely, & Salmon, 2013), and it is also an essential indicator of risk of drowning (Brenner et al., 2003; Brenner et al., 2009). It is therefore important that a reliable and valid tool for the assessment of children's swimming competence is available and that could be used on a large scale. The two studies presented in this paper examined the reliability and validity of the SCQ among primary school children in Hong Kong. In general, findings from over six thousand primary school students supported the construct validity through the factor

structure, convergent validity, concurrent validity, criterion validity, test-retest reliability, predictive validity, inter-rater reliability, and ecological validity of SCQ.

To the authors' knowledge, the SCQ is the first self-report measure of children's swimming competence that exhibits robust psychometric properties and evidence supporting a wide range of reliability and validity criteria (Hagger & Chatzisarantis, 2009). Development of precise, reliable, and valid measures such as the SCQ is important to assist in research and practice in sports medicine and exercise science (McGarry, 2009). In addition, the SCQ assesses swimming competence in terms of swimming distance in the four main swimming strokes and a combination of strokes as well as in terms of six basic swimming skills. It therefore provides a more comprehensive measure of children's swimming competence compared to other published self-report measures that rely heavily or solely on reports of overall swimming distance (Gilchrist et al., 2000; McCool et al., 2008) or subjective evaluation of swimming competence (Fife & Goldoft, 1994; Irwin et al., 2009; Langley & Silva, 1986).

Furthermore, the findings of Study 2 indicated that the SCQ is able to reliably detect improvements in overall swimming competence from pre-test to post-test in children who enrolled in a learn-to-swim program. Specifically, these data demonstrated changes in all sub-scales of the SCQ and lent support for the ecological validity of the measure. This suggests that the SCQ could potentially be used as a test battery to evaluate the effectiveness of learn-to-swim programs for primary school-aged children. Alternatively, the content of the SCQ could be used to guide the design of learn-to-swim programs for children. For example, to improve children's overall swimming competence, learn-to-swim programs could include teaching modules that specifically target components of SCQ (e.g., acquiring skills to complete specified distances in each stroke), and then evaluate whether learners had achieved better scores using the SCQ. It should be noted, however, that there are other strokes or forms of swimming that serve different purposes than those captured by the SCQ. For example, side-stroke for

life-saving or finswimming for underwater sports and swimming skills required for competitive swimming (e.g., turning, race dive) or the prevention of drowning (e.g., surface dive) are not covered in the SCQ (Moran et al., 2012). Although the focus of the SCQ is on assessing swimming competence and key survival skills that are related to swimming competence, future studies could explore the potential of covering these advanced aspects of swimming competence that relate to competitive sport and high-level water activities than to general swimming competence without sacrificing the validity and response-burden of the scale (Chan et al., 2015; Chan et al., in press; Podsakoff, MacKenzie, & Podsakoff, 2012).

Limitations and future research directions

Key advantages of the SCQ are the ease of administration and its capability to reliably and validly assess children's swimming competence (Erbaugh, 1978). Further, it has the advantage for assessing swimming competence of children on a large scale (Fife & Goldoft, 1994; Gilchrist et al., 2000; Irwin et al., 2009). Nevertheless, the SCQ is not without limitations including the potential for response bias, social desirability, and common method variance (Chan et al., 2015; Podsakoff et al., 2012). Although objective ratings from instructors correlated significantly with swimming distance and SCI scores from the measure, the relationship with swimming skills was not significant. Future research should continue to investigate the inter-rater reliability of the swimming skills dimension of SCQ and explore the possibility of developing the SCQ as an accompaniment to an objective instructor-led test battery of swimming competence.

Further limitations of the current study should also be noted. First, the SCQ was developed and validated for children; thus, the measure may not generalize to other population groups. However, given research has shown that swimming competence in adolescents and adults may be comparable to that of

children (Fife & Goldoft, 1994; Gilchrist et al., 2000; Irwin et al., 2009), future research should seek to test the reliability and validity of the SCQ in these population groups. In addition, methodological limitations were present in both Study 1 and Study 2. The cross-sectional design of Study 1 and quasi-experimental design of Study 2 precluded absolute evidence for the causal relationship between the study variables. Although the examination of causality was not within the scope of this investigation, results should be interpreted with caution. For example, the examination of test-retest reliability could have been suppressed given the learn-to-swim program was setup to enhance swimming competence. Future studies should reexamine the test-retest reliability without manipulation of swimming competence and include a longitudinal follow-up of swimming competence. Finally, the learn-to-swim program was limited to 20 lessons with a primary focus of mastering front-crawl and a few essential basic swimming skills. Although improvement of SCQ variables were observed in Study 2, future investigations should include a more comprehensive learn-to-swim program that includes longer training periods and a focus on other essential swimming survival skills (e.g., dive-in, entry) and other swimming strokes (e.g., breaststroke), to evaluate whether greater improvements of swimming competence could be adequately captured by the SCQ.

Conclusion

The swimming competence of children is an important topic of research in medicine and science in sport, but, to date, there is no tool that provides a comprehensive, valid, and reliable assessment of children's swimming competence. The present investigation aimed to fill this gap by developing the SCQ, a valid and reliable self-report measure of swimming competence. The SCQ was validated in two large-scale studies, including a cross-sectional study and a quasi-experimental study that evaluated the SCQ as a measure of swimming competence in primary school-aged children in Hong Kong. The findings provided preliminary support for the construct validity and factor structure, convergent validity,

concurrent validity, criterion validity, test-retest reliability, predictive validity, inter-rater reliability, and ecological validity of the scale. Based on current evidence, the SCQ performs well as a tool for evaluating children's swimming competence, and the swimming competence index is related to swimmers' self-efficacy, intention, and frequency of swimming. The scale should be validated in other populations and cultural groups as it has the potential to assist practitioners in evaluating children's swimming competence as well as provide a basis for program design and evaluation of learn-to-swim programs.

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Disclosure Statement

The authors declare no conflict of interests.

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Table 1. Correlation matrix, distribution, and validity indices of Study 1's variables

	1	2	3	4	5	6
1. Distance	1					
2. Skills	0.82**	1				
3. Swimming competence index	0.93**	0.96**	1			
4. Self-efficacy	0.38**	0.38**	0.36**	1		
5. Intention	0.32**	0.33**	0.31**	0.81**	1	
6. Swimming frequency	0.39**	0.73**	0.41**	0.35**	0.32**	1
Mean	5.92	4.17	28.03	4.19	4.05	2.88
SD	6.73	1.95	18.73	1.92	2.09	3.25
Cronbach's Alpha	0.91	0.84	0.87	0.94	0.95	N/A
AVE	0.87	0.78	N/A	0.76	0.86	N/A
Rage of Shared Variance	0.10–0.15	0.11–0.53	0.10–0.17	0.12–0.14	0.10–0.11	0.15–0.53
Range of Factor Loading	0.89-0.99	0.78-0.95	N/A	0.76-0.92	0.88-0.96	N/A

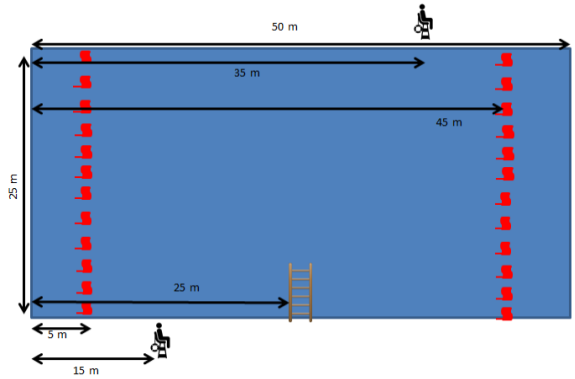
* $p < 0.05$, ** $p < 0.01$

Appendix A

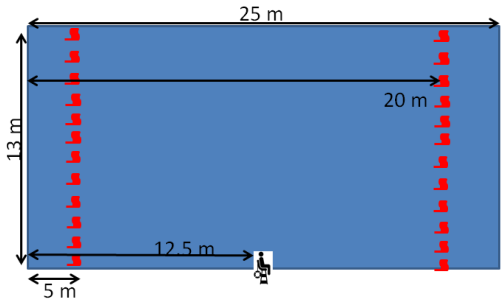
Swimming Competence Questionnaire

1. Swim Distance

a) The furthest distance you can swim **without any assistance or rest**.



Standard Swimming Pool



Short Swimming Pool

**If you do not know the exact distance, please make the closest approximation.*

☐ I don't know how to swim/ never swam before

☐ The furthest distance is _____m

2. Swim Competence

a) Breaststroke  _____m

b) Front-crawl  _____m

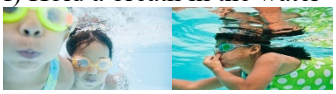
c) Backstroke  _____m

d) Butterfly  _____m

e) Swimming underwater

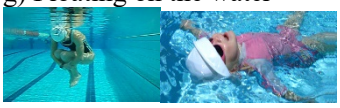
☐I can ☐I can't

f) Hold a breath in the water



☐I can ☐I can't

g) Floating on the water



☐I can ☐I can't

h) Poolside Kicking (any strokes)

☐I can ☐I can't

i) Kicking with kickboard (any strokes)

☐I can ☐I can't

j) Treading Water (any stroke/ways)

☐I can ☐I can't

Scoring Instruction:

1. Swimming distance is categorized into “very weak” (0m – 4.99m), “weak” (5m –12.49m), “beginner” (12.5m – 24.99m), “intermediate” (25m – 49.99m), “good” (50m – 99.99m), and “excellent” (>100m), and scored on a 6-point Likert scale (0 = “very weak” to 5 = “excellent”).

2. Basic swimming skills were scored on a dichotomous scale (0 = “I can’t” and 1 = “I can”).

3. *Swimming competence index* (SCI) can be calculated by the following algorithm. It is an index of overall swimming competence that ranged from 0 (i.e., “incompetent”) to 100 (i.e., “competent”).

$$\text{Swimming Competence Index} = 100 \times (\text{General}_{\text{score}} \times 2 + \text{MEAN}(\text{Front-Crawl}_{\text{score}}, \text{Breaststroke}_{\text{score}}, \text{Backstroke}_{\text{score}}, \text{Butterfly}_{\text{score}}) \times 2 + (\text{Poolside Kicking}_{\text{score}} + \text{Kickboard Kicking}_{\text{score}} + \text{Holding Breath Underwater}_{\text{score}} + \text{Floating}_{\text{score}} \times 2 + \text{Treading Water}_{\text{score}} \times 2 + \text{Swimming Underwater}_{\text{score}} \times 3) \div 30$$

Appendix B

Content of learn-to-swim program

1. Warm-up and preparation (in pool/ out of pool)
2. Early practice
2.1 Aqua walking
2.2 Holding breath underwater
2.3 Breathing exercise
2.4 Floating and stationary exercise
2.5 Gliding exercise
3. Front-crawl kicking practice
3.1 Poolside kicking (sitting position)
3.2 Poolside kicking (holding the pool edge, head up)
3.3 Poolside kicking (head down, holding breath)
3.4 Poolside kicking (head up only for breathing)
3.5 Near poolside kicking (arms pushed away from the edge and return)
3.6 Front-crawl kicking (jump start from the bottom of the pool)
3.7 Front-crawl kicking (jump start from the pool wall).
3.8 Kickboard kicking (head up)
3.9 Kickboard kicking (head down, holding breath)
3.10 Kickboard kicking (head up only for breathing)
3.11 Kickboard kicking (holding kickboard with single arm)
4. Front-crawl pulling practice
4.1 Pulling on the ground (single-arm and alternate-arm)
4.2 Pulling whilst standing in the pool (single-arm and alternate-arm)
4.3 Single-arm pulling with poolside kicking (head down, holding breath)
4.4 Single-arm pulling with poolside kicking drills (head up only for breathing)
4.5 Alternate-arm pulling with poolside kicking drills (head down, holding breath)
4.6 Alternate-arm pulling with poolside kicking drills (head up)
4.7 Alternate-arm pulling with poolside kicking drills (head down, holding breath)
4.8 Alternate-arm pulling with poolside kicking drills (head up only for breathing)

4.9 Alternate-arm pulling with kicking

4.10 Alternate-arm pulling with pull buoy

1. Front-crawl pulling with forward movement assistance

5. Coordination of kicking and pulling

5.1 Single-arm pulling with kickboard kicking (head down, holding breath)

5.2 Single-arm pulling with kickboard kicking (head up only for breathing)

5.3 Alternate-arm pulling with kickboard kicking (head down, holding breath)

5.4 Alternate-arm pulling with kickboard kicking (head up only for breathing)

5.5 Front-crawl (head down, holding breath)

5.6 Front-crawl (head up only for breathing)

6. Front-crawl technique improvement