Original Article

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Towards a Consensus on the development of the Aquatic Curricula Analysis Tool using an Ecosystem Approach: A Delphi Method

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Abstract: Background: Physical inactivity and drowning are two of the leading causes of death worldwide. While participation in aquatic physical activity can help reduce these public health challenges, it is crucial to equip young people with key water skills through a well-designed aquatic curriculum to protect them from drowning and engage them in the long term in aquatic physical activities. This study reports on the development of a tool to analyse aquatic curricula for 6-to-12-year-olds in Europe, addressing both aquatic health issues. Methods: Using a three-round Delphi method, 101 participants from eight European countries - including experts in teaching, organising and researching aquatic education - were asked to rate the relevance of criteria conceptualised through Bronfenbrenner's ecological model. Results: 115 criteria were retained and grouped into eight categories: (1) curriculum management, (2) drowning epidemiology, (3) timetable, (4) location and equipment, (5) staff, (6) content, (7) assessment and (8) learners. The strong consensus on most of the criteria suggests that promoting physical activity and water safety are compatible goals. Conclusion: A well-designed aquatic curriculum, rooted in each level of the ecological model and organised through a multisystemic approach, can successfully achieve both objectives. The findings provide valuable insights for the design of aquatic safety promotion policies, as well as guidance for educators and policy makers to improve teaching strategies to increase physical activity while preventing drowning accidents.

Keywords: Curriculum design, Water safety, Physical activity promotion, Delphi study

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INTRODUCTION

The term "disease of civilisation", as introduced by Welian-Polus et al. [1], describe the social and health consequences of a sedentary lifestyle. Alarmingly, nearly 80% of young people globally are considered physically inactive [2], prompting researchers to warn about the long-term impact of this inactivity on future generations [3]. Against the backdrop of these epidemiological tends, it become crucial to reimagine the in-school, out-of-school and multisectoral strategies [4] to develop curricula that (re)engage young people in Physical Activity (PA).

Among the diverse activities favored by young people worldwide, Aquatic Physical Activities (APAs) stand out for their physical, mental and social health benefits [5]. However, the lack of basic skills, knowledge and attitudes often prevents participation in APAs [6], making them risky for many. This deficiency is a major contributor to drowning, which claims approximately 236,000 lives annually, predominantly among young people under the age of 14, representing the leading cause of unintentional death in this age group across several countries [7]. Recognizing these challenges, organizations such as the *World Health Organization* and the *Organisation for Economic Co-operation and Development* (OECD) have urged stakeholders and educators to address these issues by improving the quality of PA [8] and aquatic education curricula [9]. These advancements should focus on fostering foundational skills essential for adopting healthy, active lifestyles while promoting the safe practice of APAs.

The Curriculum at the Heart of the Ecological Model

To ensure optimal aquatic education, it is crucial to provide young children with opportunities to experience a meaningful, safe and sustain aquatic curricula. However, the concept of 'curriculum' is often debated [10] with some defining it as a 'written school programme' and others viewing it as a broader 'set of learning experiences'. This multidimensional concept [11] is shaped by the interactions among the *formal curriculum* (e.g., hierarchical and institutionalised set of contents, school tasks and procedures, which defines what is supposed to be taught and learned; [12]), the *hidden curriculum* (i.e., knowledge that is implicitly transmitted to an individual through their interactions with social and material environment; [13]), and the *tested curriculum* (e.g., what is being tested by policymakers; [14]).

This study examines aquatic curriculum holistically, emphasizing not just the *formal curriculum,* drawing together content written by stakeholders and its implementation in a top-down manner, but also the interplay among various institutions (e.g., schools, federations, associations) and actors (e.g., school, teacher, family) that may have either a positive or negative impact [15] on children's aquatic development. Researchers in water safety [16] and PA promotion [17] underscores the need for multisectoral collaboration to make curricula more effective.

To address these complexities, the Ecological System Model (EST; [18]) offers a valuable framework to analyse the aquatic curriculum. Adopted as part of the OECD Education 2030 project [19] initiative, the EST [18] considers the individual development as shaped by a "set of nested structures, each inside the other like a set of Russian dolls" [20, p.3] that have a lasting impact on their behaviours. The systems are ranging from the microsystem (e.g., family, school), to the broader macrosystem (e.g., country culture, norms and values) and anchored in a chronosystem. This model has been applied to PA promotion, identifying factors that sustain healthy and active lifestyles [21].

Transposition Towards an Aquatic Curriculum

The EST offer a valuable framework for identifying key factors that can contribute to the development of an aquatic curriculum designed to educate young people engaging in APAs in a safe and sustainable way. At the core of the model, the *microsystem* represents

a "pattern of activities, social roles, and interpersonal relations experienced [that…] permit, or inhibit engagement sustained […] in the immediate environment" [20, p.39]. This level captures the interactions that the individual may experience with their immediate environment (e.g., school, home, neighbourhood) and key social exchanges (e.g., with family, teachers, peers). Research in aquatic education and PA promotion emphasises the importance of proximal development at this level. Effective safe engagement in APAs can be fostered through measures such as the integration of parents in intervention programmes [22], the creation of greater diversity in environmental settings [23] and aquatic environments (e.g., rough, open water, waves, cold water; [24]), or locations to develop social skills [25]. At the next level, the *mesosystem* represents the "linkages and processes taking place between two or more settings containing the developing person" [20, p.40], such as the link family-school or school-out-of-school learning institutions. Research underscores the importance of bridging these contexts to reduce gaps in learning and enhance APA development through collaborations among professionals and stakeholders [17,18]. Then, the *exosystem*, meanwhile, includes "linkages and processes taking place between two or more settings, at least one of which does not contain the developing person, but in which events occur that indirectly influence" their development [20, p.40], such as teacher and educator training, which play an important role in equipping instructors to create positive and safe aquatic experiences for children. This insight is mirrored in PA promotion programmes [26]. Encompassing these systems is the *macrosystem*, described as the "overarching pattern of micro-, meso-, and exosystems characteristic of a given culture or subculture" [20, p.40]. This level reflects the cultural, societal, and historical context in which the curriculum is developed [10]. Researchers have emphasised the importance of national epidemiological data in shaping aquatic curricula towards 'what to teach' and 'how to implement' to address drowning prevention and PA promotion issues. Stakeholders' role in the macrosystem is to build *formal curricula* that integrate essential knowledge and competencies that needs to be taught. Certain theoretical frameworks provide clues to enrich 'what needs to be taught' to protect young people from drowning incidents (e.g., Water Competencies; [27]) and to make these behaviours last throughout the lifecourse (e.g., Physical Literacy; [25]). Last, the *chronosystem* is the third dimensional system of the model, which "encompasses change or consistency over time, not only in the characteristics of the person but also of the environments in which the person lives" [20, p.40]. This system highlights key elements such as policies defining the minimum age for education, programme duration and broader public policies shaping expectations and standards. In this respect, research has examined the following questions: 'at what age' should motor skills [28] and aquatic skills development [29] begin, or 'how many hours should a learn-to-swim programme last' to be effective [30].

Empirical evidence presented above clearly shows that aquatic development occurs at the corner of these five EST systems (i.e., micro-, meso-, exo-, macro- and chronosystems). The physical deficiency of the younger generations and the dramatic epidemiological statistics of drowning in Europe underscore the weaknesses in current aquatic curriculum framework to effectively protect and engage children. Although progress has been made in defining 'what to teach', 'when to teach' in the *formal curriculum* to address drowning prevention and (A)PA promotion, limited efforts have been directed at analysing aquatic curricula through the lens of EST, considering all the interactions between system levels.

Therefore, this study aims to address this gap by developing the Aquatic Curriculum Analysis Tool (ACAT) for children aged 6 (compulsory schooling in Europe) to 12-year-olds (end of primary education in Europe). The ACAT aims to evaluate whether European aquatic institutions provide conditions to protect young people from the risks of drowning and involve them in APAs in a sustainable way. The Delphi method was used to identify criteria for analysing the relevance of the curriculum (i.e., addressing both health issues) focusing on the involvement of all system levels. Given the institutional rather than

pragmatic nature of this study, the EST was deliberately selected, rather than the theoretical Person-Process-Context-Time [31] as recommended by Tong and An [32]. Furthermore, this tool has been developed with the participation of experts from different European countries to: (1) identify culturally specific criteria related to the macrosystems, (2) facilitate international sharing, and (3), support cross-sectorial comparison to identify strengths and weaknesses. These insights aim to guide stakeholders and instructors in improving public policy and enhacing education for sustainable practice in aquatic environments.

MATERIAL AND METHODS

Study design

A 3-round Delphi protocol was employed to achieve expert consensus on a specific research question [33]. The question guiding the study was: "What are the criteria for analysing whether an aquatic curriculum can safely and sustainably engage young people aged 6-to-12-year-olds in aquatic physical activities?". Data collection was conducted using three online questionnaires, completed individually by participants between April 2020 and May 2021.

Participants recruitment

Inclusion criteria were defined to select the most appropriate participants from eight European countries (i.e., Belgium, Czech Republic, France, Germany, Hungary, Norway, Poland, Portugal) to respond to the research question. The inclusion criteria were: (a) ability to understand and answer simple questions in English, (b) professional involvement in teaching, organising or researching aquatic education for children aged 6-to-12-year-olds, (c) at least 10 years of professional experience for educators and stakeholders [34] or published research in the field of aquatic education for researchers. A heterogeneous group of professionals was selected to ensure the validity of the findings [35]. Experts were identified through recommendations from researchers in Belgium (K.DM; *n*=28), Czech Republic (L.M; *n*=16), France (F.P; *n*=41), Germany (I.S; *n*=22), Hungary (Z.K; *n*=21), Norway (B.H.O; *n*=38), Poland (M.R; *n*=14) and, Portugal (S.S; *n*=39). The 219 participants contacted were from diverse fields including: (1) swimming instruction, (2) swimming coaching, (3) teaching, (4) lifesaving, (5) politics, and (6) research, in each country. All participants completed a pre-questionnaire to confirm their eligibility.

Procedure and instrumentalisation

The Delphi process adhered to the guidelines outlined by Stewart and Shamdasai [36], consisting of the following steps: (1) development of the initial question, (2) selection of experts, (3) dissemination of the round-I questionnaire, (4) collection of the round-I responses, (5) analysis of round-I responses and creation of the round-II questionnaire, (6) dissemination of the round-I results and round-II questionnaire, (7) collection of the round-II responses, (8) analysis of round-II responses and creation of the round-III questionnaire, (9) dissemination of the round-II results and round-III questionnaire, (10) collection of the round-III responses, (11) final analysis, (12) dissemination of the results to the participants.

The experts were surveyed using an online questionnaire. No personal information was requested from the participants and the questionnaire was distributed using blind carbon copy to minimise peer influence [37]. Participants were given three weeks to respond to each questionnaire, with reminders sent during an additional two-week period for non-responders before exclusion from the study.

Each questionnaire comprised three sections: (1) presentation of the research question for Round-I or the responses from the previous round for Round-II and Round-III, (2) analytical criteria to be rated and (3) open-ended questions to provide feedback or

suggest additional criteria. The relevance of each proposed criterion was rated on a 5-point Likert-type scale [38], ranging from 1 ('not at all relevant') to 5 ('very relevant').

Round-I

Participants were asked to rate the relevance of criteria related to: (1) curriculum management (*n*=3), (2) drowning epidemiology (*n*=3), (3) timetable (*n*=3), (4) location and equipment (*n*=7), (5) staff (*n*=7), (6) content (*n*=3), (7), assessment (*n*=1) and (8), learners (*n*=4). Open-ended questions in each section allowed participants to add new criteria.

Round-II

Criteria selected in Round-I were presented to the participants. They were asked to rate the relevance of criteria proposed in the open-ended questions of Round-I (*n*=5) and the criteria related to: (1) curriculum management (*n*=11), (2) drowning epidemiology (*n*=10), (3) timetable (*n*=4), (4) location and equipment (*n*=10), (5) staff (*n*=3), (6) content (*n*=25), (7), assessment (*n*=13) and (8), learners (*n*=1). Criteria in the *'content'* domain were related to water safety, based on the concept of Water Competencies [27].

Round-III

Criteria selected in Round-II were presented to the participants. They were asked to rate the relevance of the criteria proposed in the open-ended questions of Round-II (*n*=19) and the criteria related to: (1) curriculum management (*n*=7), (4) location and equipment (*n*=5), (5) staff (*n*=1), (6) content (*n*=19), (7), assessment (*n*=1) and (8), learners (*n*=1). Criteria in the *'content'* domain were related to sustained engagement in PA, incorporating elements of Physical Literacy [25].

Data analysis

Data were transcribed into an Excel spreadsheet for analysis. Comments added by participants in Round-I and Round-II were analysed and proposed in Round-II and Round-III, respectively. The cumulative frequencies of 'relevant' and 'very relevant' for each criterion were retained and converted into consensus percentages. A consensus threshold of 55% was set by the upstream researchers, as recommended by Powell [39]. Criteria with agreement rate exceeding this threshold were retained.

RESULTS

Characteristics of the participants

Table 1 presents the characteristics of the experts who participated in the Round-I, -II and -III. One hundred and one participants met the inclusion criteria for Round-I, 82 in the Round-II, and 60 for the Round-III. The comments suggested by the participants in the open comments of Round-I (discussed later in this paper) prompted a re-evaluation of the analysis framework. Initially based on the layers of the EST model, the criteria were reorganised using Harden's curriculum mapping framework [40], which was adapted by the authors for application to the aquatic curriculum. The analyse was thus categorised into eight categories: (1) curriculum management, (2) drowning epidemiology, (3) timetable, (4) location and equipment, (5) staff, (6) content, (7), assessment and (8), learners.

Round I

The results of Round I are presented in Table 2. All the criteria proposed in the Round-I questionnaire were retained achieving an average agreement rate of 81% among the experts, except for the criteria related to the age of the instructor teaching 'learn-to-swim' (only 27% agreement).

Table 1. Demographical characteristics of the participants in each round

Criteria for division	Field	Round I (n=101)	Round II (n=82)	Round III (n=60)
Field of work	Swimming instructors	14 (14%)	12 (15%)	9 (15%)
	Swimming coaches	21 (21%)	15 (18%)	11 (18%)
	Teachers	13 (13%)	9 (11%)	7 (12%)
	Lifeguards	10 (10%)	5 (6%)	3 (5%)
	Stakeholders	20 (20%)	19 (23%)	14 (23%)
	Researchers	23 (23%)	22 (27%)	16 (27%)
Country	Belgium	6 (6%)	6 (7%)	5 (8%)
	Czech Republic	4 (4%)	1 (1%)	0 (0%)
	France	25 (25%)	18 (22%)	10 (17%)
	Germany	8 (8%)	6 (7%)	4 (7%)
	Hungary	5 (5%)	5 (6%)	5 (8%)
	Norway	23 (23%)	19 (23%)	16 (27%)
	Poland	9 (9%)	7 (9%)	5 (8%)
	Portugal	21 (21%)	20 (24%)	15 (25%)

Table 2. Round I results

Domain	Sub-domains	Agreement%
Curriculum management	National compulsory swimming instruction	92*
	Institution that governs swimming instruction	91*
	Learning free or not	61*
Drowning epidemiology	Number of drownings per year in the country	93*
	Characteristics of people who drown	94*
	Main causes of drowning in the country	94*
Timetable	Standard age to start swimming instruction	98*
	Standard number of teaching hours	97*
	Time duration of a lesson	88*
Location and equipment	Indoor or outdoor setting	79*
	Deep or shallow water	93*
	Hot or cold water	80*
	Flat or rough water	85*
	Use of clothes	69*
	Use of equipment (e.g., sinking toys)	69*
	Use of swimming aids	76*
Staff	Age of instructors	27
	Volunteer or not	56*
	Specialisation	70*
	Type of education	86*
	Skills	77*
	Swimming instructor training	94*
	Institution to which the swimming instructor belongs	82*
Content	Motor skills taught	95*
	Knowledges taught	94*
	Attitudes taught	89*
	Use of aids	72*
Assessment	"Can Swim" assessment test	94*
Learners	Age of children	96*
	Groupe size	96*
	Inclusion of children with disabilities	85*
	Ratio of children benefiting from swimming teaching	97*

*Consensus (set at 55%)

Round-II

The results of Round-II are presented in Table 3. Most criteria proposed in the Round-I questionnaire were retained, with an average agreement rate of 74%. Several criteria fell below the consensus threshold, including: the sex of people drowning (48%), morning or afternoon lessons (18%), the utilisation of swimming pool steps (48%), possibility of wearing goggles (45%) or nose clips (17%), use of a pole in lessons (40%), use of buoys (49%) during learn-to-swim sessions, to learning to swim with a lifejacket (45%) and learning the World Aquatics approved strokes (44%).

Round-III

The results of Round-III are presented in Table 4. Most criteria proposed in the Round-III questionnaire were retained with an average rate of 73%. Exceptions included criteria such as: the number of lifeguards in the country (42%), use of fins (49%), use of equipment during the test (49%), employer of the practitioner (43%) and order of tasks in the test (49%).

Table 3. Round II results

Domain	Sub-domains	Agreement%
Curriculum management	Organisation in which the swimming instruction is compulsory	95*
	Level at which this swimming instruction is compulsory	78*
	When swimming instruction is compulsory	93*
	Regulatory framework governing the aquatic education program(s)	83*
	Regulatory framework for swimming pool access	72*
	Common program between institutions	70*
	Common objectives between institutions	78*
	National drowning prevention system	78*
	Regulatory framework used during swimming teaching	83*
	Swimming culture in each country[a]	84*
	Parents expectations taken into account[a]	72*
Drowning epidemiology	Number of drownings among 6-12 years old per year in the country	93*
	Total number of drownings per year in the country	85*
	Sex of drowning people	48
	All causes of drownings per year in the country	89*
	Main causes of drownings among 6-12 years old	94*
	Social classes most affected by drowning	77*
	Drowning locales	91*
	Evolution of drowning frequency over the last few years by country	87*
	Geographical characteristics of each country	71*
	Easy access to drowning reports in each country	79*
Timetable	Massed or distributed practice in lessons	87*
	Number of lessons per week	90*
	Morning or afternoon lesson	18
	Age at which most swimming lessons are given	94*
Location and equipment	Learning to swim with clothes	73*
	Use of swimming pool steps	48
	Learning to swim with googles	45
	Learning to swim with nose clips	17
	Use of pole	40
	Use of floating boards	72*
	Use of buoys	49
	Learning to swim with a lifejacket	45
	Frequency with which equipment is used	60*
	Why equipment is used (e.g., floating, enjoying, learning)	74*

Continued ...

Domain	Sub-domains	Agreement%
Staff	Practitioner's degree	99*
	Salary	66*
	Partnership and collaborative work	74*
Contents	Teaching entry into water	87*
	Teaching breath control	96*
	Teaching floating on the front	95*
	Teaching floating on the back	98*
	Teaching treading water	87*
	Teaching rolling in the water	91*
	Teaching turning	87*
	Teaching swimming on the front	100*
	Teaching swimming on the back	99*
	Teaching World Aquatics strokes	44
	Teaching surface diving	83*
	Teaching underwater swimming	96*
	Teaching deep water diving	79*
	Teaching deep water exiting	87*
	Teaching exiting from water with clothes	77*
	Teaching exiting from water with a high bank	72*
	Teaching exiting from different surfaces	74*
	Teaching emergency numbers to call	82*
	Teaching clothing colours worn by rescue staff	61*
	Teaching self-assessment	89*
	Teaching how to recognise a drowning person	90*
	Teaching how to assist a drowning person	87*
	Perceived pleasure during swimming lessons	90*
	Inclusion of international lifesaving standards[a]	73*
	Cooperation with other subjects when teaching is at school[a]	76*
Assessment	Examiner qualifications	90*
	Swimming distance value	78*
	Combination of motor tasks	85*
	Motor skills assessed	98*
	Knowledge assessed	83*
	Adaptive scenarios used	80*
	Compulsory test for all children	82*
	Tasks experienced before taking the test	74*
	Number of attempts for the test	61*
	Award delivered for success	73*
	Number of levels	72*
	Number of children who pass the test each year	80*
	Task most failed in the test	67*
Learners	Involvement of parents in aquatic education[a]	72*

[a]Criteria suggested by the experts; *Consensus (set at 55%).

Table 4. Round III results

Domain	Sub-domains	Agreement%
Curriculum management	Data sharing between institutions at a local level[a]	67*
	Links between the evolution of drowning and swimming education programmes[a]	75*
	National budget for swimming education[a]	73*
	General costs of a 'learn-to-swim' system[a]	67*
	Price of a lesson for parents[a]	77*
	Amount of swimming facilities per inhabitant[a]	85*
	Number of lifeguards employed in the country[a]	42
Location and equipment	Use of noodles[a]	60*
	Use of diving toys[a]	92*
	Use of fins[a]	49
	Use of equipment during tests[a]	49
	Test locale (controlled environment or not)[a]	72*
Staff	Practitioner's employer[a]	43
Contents	Developing enjoyment	98*
	Developing confidence	97*
	Developing motivation	83*
	Developing emotional self-regulation	88*
	Developing physical self-regulation	77*
	Developing relationships with other group members	90*
	Developing collaboration between members	83*
	Developing equity in the group	87*
	Proposals for an inclusive programme	90*
	Developing respect of the children's integrity	93*
	Teaching risk understanding	95*
	Teaching planification strategies	78*
	Teaching tactics	70*
	Teaching perceptual awareness	88*
	Teaching risk management for others	85*
	Teaching breaststroke legs action[a]	58*
	Teaching swimming on the side[a]	65*
	Teaching how to move from a vertical to a horizontal position[a]	95*
	Teaching eggbeater legs kicks[a]	62*
Assessment	Order of tasks in the test[a]	49
Learners	Parents involvement in the success of 'learn-to-swim'	85*

[a]Criteria suggested by the experts; *Consensus (set at 55%).

DISCUSSION

Implementing a Delphi methodology, this study aimed to develop the Aquatic Curriculum Analysis Tool (ACAT), designed to evaluate whether European institutions delivering "learn-to-swim" programmes for children aged 6-to-12-year-olds ensure safe and sustainable participation in APA.

A multi-actor consensus

This study brought together experts from diverse professional backgrounds across the microsystem (i.e., swimming instructors, teachers, coaches), mesosystem (e.g., swimming pool managers) and macrosystem (e.g., policymakers responsible for national programmes) levels. Despite the heterogeneity of professional backgrounds across eight countries, the study achieved a high level of agreement, with a mean consensus rate of 76% across all rounds. The strong consensus serves as a significant asset for improving aquatic curricula, both in terms of teaching content, and in the implementation of policies within specific regions. It shows potential for transnational harmonisation, particularly

through stakeholders' involvement in the Delphi process [41]. These findings highlight critical interrelationships among the key factors required for implementating protective and engaging aquatic curricula. They underscore the necessity for effective coordination among stakeholders and institutions involved in the design and implementation of aquatic curricula.

Structural Complexity for Relevant Analytical Criteria

Studies have shown the need to strengthen partnerships between the sectors involved in reducing physical inactivity [17] and drowning accidents [42]. Although the EST model served as a foundation for the initial analytical framework and the definition of proposed criteria, participants' open-ended comments revealed challenges in applying Bronfenbrenner's model to aquatic curricula due to differences in national legislative frameworks. In fact, the national legislative frameworks that regulate the 'learn-to-swim' programmes impacted the organisation of the ecological model's systems. For instance, some countries mandate swimming lessons at a national level as part of the formal curriculum (e.g., France, Norway). Others incorporate such lessons regionally or when they have the facilities for (e.g., Germany, Belgium, Hungary, Poland), while some restrict aquatic education to a local level in out-of-school settings (e.g., Czech Republic, Portugal). This variability in how macro- and mesosystems are structured across nations complicates the application of Bronfenbrenner's model and underscores the need for a more adaptable approach. To address these discrepancies, the authors developed a standardised assessment tool based on a modified classification of curriculum mapping originally proposed by Harden [40]. This approach provides a more effective framework for identifying the strengths and weaknesses of each nation's aquatic curricula while facilitating future cross-sectoral and European-wide comparisons. The Supplementary Material 1 is showing the aquatic curriculum mapping regarding the criteria retained as relevant by the participants in the study.

Consistent analysis criteria

Given the structural complexity of aligning elements to the EST model, the study reorganised the criteria into eight categories: (1) curriculum management, (2) drowning epidemiology, (3) timetable, (4) location and equipment, (5) staff, (6) content, (7), assessment and (8), learners.

Curriculum management

All criteria related to curriculum management were fully validated, emphasising compulsory 'learn-to-swim' instruction and free access, advocating for accessible education for the largest number of children from an early age. Recently, the United Nations has highlighted the importance of integrating aquatic education into school curricula to significantly reduce drowning accidents [43].

Drowning epidemiology

Participants identified on the relevance of examining the causes, locations and populations most at risk of drowning, to design aquatic education programmes. This finding is consistent with a new way of thinking in aquatic education, where "the causes of drowning should dictate the way, we teach swimming and what children should learn" [44]. Notably, the sex of drowning victims was not retained as relevant, despite epidemiological data showing men are at twice the risk of drowning compared to female [45]. An explanatory hypothesis could be the projection of the experts on the complexity of separating girls and boys into different groups, mostly constructed by administrative means, or on possible pedagogical and didactic differentiation during teaching. Consequently, sex-neutral education should be developed in aquatic curricula, according to Delphi participants' responses.

Timetable

Most criteria were validated with over 87% agreement. They mainly concerned the number and duration of lessons and the age at which children should start learning to swim. This outcome aligns with empirical studies advocating the initiation of swimming instruction around age four to optimise safety and skill development [28,29]. However, regarding the required number of hours to acquire basic aquatic skills [30] and the optimal frequency of sessions, it remains the subject of debate [46]. The lesson time of day (morning or afternoon) has not been considered as a relevant criterion for analysing the aquatic curriculum, and no empirical evidence currently supports its significance.

Location and equipment

This category revealed the most contentious opinions, with agreement rates ranging from 40% to 50%, with half of the criteria being rejected. The debate about equipment, particularly floating aids and deep/shallow water, is also a matter of discussion in the scientific literature. Less controversial criteria include clothed swimming and using diverse aquatic settings (e.g., flat, rough, cold waters). Since most drownings occur in open water after falls while clothed, this criterion is aligned with recommendations from several studies that encourage instructors to teach in open water [47,48] and with clothes [49]. Surprisingly, the criterion of learning to swim with a lifejacket was not retained by the experts (45% agreement). While water safety programmes emphasise the regulations surrouding the use of lifejackets in the practice of APAs [45], the specific criterion of teaching swimming with a lifejacket failed support among the experts. This result could be attributed the lack of rigour lifejackets regulations across the countries surveyed or the limited use of lifejackets by the instructors involved in the study. Notably, most of the instructors questioned work in swimming pools environments where the use of lifejacket may be perceived as unnecessary or irrelevant to their teaching practices.

Staff

The staff category brings together all the criteria relating to the status, training and competence of instructors and the way the groups of children are managed. Given the inherent risks of aquatic environments, experts emphasised the need for instructors to possess safety competencies that go beyond the pedagogical approach of a land-based PA [50]. Experts agreed that water safety should be taught by instructors who have basic safety skills, knowledges of body dynamics in water (e.g., buoyancy, body lift), and the ability to manage emergencies (e.g., assisting a person in distress).

Contents

All criteria in the programme content category were retained, with the exception of *'teaching World Aquatics strokes'*. Validated criteria align with the consensual model of Water Competencies [27], which outlines the motor skills, knowledge and attitudes required for safe aquatic engagement in, on and around the water.

Participants also supported unanimously integrating contents to sustain participation in APAs (i.e., all the contents in the *'programme contents'* category of Round-III), inspired and adapted from the Australian Physical Literacy Framework [25]. With over 70% agreement for each criterion, this result underscores the belief that promoting sustained APA participation and ensuring water safety are compatible goals, as reflected in the emerging concept of *'Aquatic Literacy'* [46].

Assessment

Criteria for evaluating aquatic skills through testing were retained, focusing on the legal framework for implementation (e.g., obligation, certification, staged organisation, number of children passing, number of attempts), and the possibility to assess the adaptation of the children to face new tasks (e.g., combined tasks, adaptative scenario,

tasks known before passing). Only the criterion of the order of the tasks in a test was not retained as relevant (49% agreement). Although the studies show the need to combine motor tasks to demonstrate individual adaptability [24,27], future studies are needed to find out which tasks should be combined in a particular order.

Learners

Criteria related to learners were validated, with participants agreeing on the importance of parental involvement in aquatic education. This finding suggests the need for a dynamic teacher-parent-child model within the microsystem to foster safe and sustainable aquatic education [22].

LIMITS AND PERSPECTIVES

The development of the Aquatic Curriculum Analysis Tool (ACAT) offers significant opportunities for researchers, educators and policymakers to analyse, compare and improve aquatic curricula in Europe. By comparing data with their European counterparts, policymakers can identify strengths and areas for improvement within key categories: (1) curriculum management, (2) drowning epidemiology, (3) timetable, (4) location and equipment, (5) staff, (6) content, (7), assessment and (8), learners. The validated criteria behind each category can inspire revisions that enhance the protection and participation of children in APAs for the long term. The criteria serve as a comprehensive guide for stakeholders to examine the interactions between institutions (e.g., schools, federations, associations) and actors (e.g., policymakers, instructors, parents, children) in implementing an effective aquatic curriculum for 6- to 12-year-olds within their national contexts. Following an internal and external validation, the ACAT is ready for assessing and comparing aquatic curricula in the European context.

Despite its contributions, this study presents several limitations. In fact, the 40% drop out of participants between the Round I (n=101) and the Round III (n=60) resulted in an overrepresentation of certain countries (e.g., Norway and Portugal). This may be attributed to the predominance of practitoners in the study who may not frequently use English in professional settings. However, the professional backgrounds of experts remained balanced across rounds. To enhance the applicability of ACAT across other nations contexts, future research should consider translating the questionnaire in national languages.

Finally, this study identifies criteria deemed relevant by the experts for evaluating whether national aquatic curricula in Europe address the dual challenges of prevention and sustained participation in APAs. While the empirical evidence highlights the importance of local policies (e.g., communities programmes, norms and values of ethnical minorities [6, 51]), these elements were not explicitly addressed in this European study. Future research should explore the structural conditions required to design effective aquatic curricula across international, national, and local contexts.

CONCLUSION

This study aimed to establish a robust set of criteria for analysing aquatic curricula across Europe, focusing on their capacity to protect and sustainably engage children aged 6-to-12-year-olds in APA. While Bronfenbrenner's Ecological Systems Theory (EST) model initially informed the tool's design the study outcomes indicate the need for a more streamlined framework. Consequently, eight categories were established to better capture the complexities of aquatic curricula.

The high-level consensus achieved among experts highlights a strong potential for linking PA promotion and drowning prevention through a well design aquatic curricula. The ACAT provides a valuable framework for identifying the strengths and weaknesses of

national education systems, offering a pathway for benchmarking and adopting best practices.

Future studies could apply this tool to guide policy development, by identifying potential strengths and weaknesses within national education systems. By fostering synergies among institutions, stakeholders, and policymakers, and identifying "best practices", the ACAT has the potential to significantly enhance the effectiveness and sustainability of aquatic curricula, ensuring greater protection and long-term participation of children in APAs across Europe.

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