

USFD Journal

of Physical Education Pedagogy & Sports Performance

Lamos Publishing OPC · Peer-Reviewed · Open Access

Vol. 2 (2) · June 2026

3082-5725 (Online) · DOI prefix 10.64339/USFD-

RESEARCH ARTICLE

Development and Content Validation of a Test for Aerobic Control

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RECEIVED May 26 2026

PUBLISHED 15 June 2026

ACCEPTED June 9 2026

DOI 10.64339/USFD-09xm8792

CITE AS Tutica, C. M. T. (2026). Development and content validation of a test for aerobic control. *USFD Journal of Physical Education Pedagogy & Sports Performance*, 2(2), 209–233. <https://doi.org/10.64339/USFD-09xm8792>

ABSTRACT

Aerobic control, defined as the ability to regulate breathing, heart rate, and exercise intensity during physical activity, remains underrepresented in Physical Education (PE) assessment, where existing tools predominantly measure aerobic capacity and endurance. This study aimed to develop and refine an Aerobic Control Test for college students using a research and development (R&D) design anchored on the ADDIE framework. The process involved expert-informed drafting, content validation, and try-out implementation of the assessment tool. Five experts contributed to the test's conceptualization, while three validators evaluated its content using a Content Validity Evaluation Form. Results of the item-level Content Validity Index (I-CVI) indicated strong agreement, with most items rated highly valid, and selected components were revised to improve clarity, standardization, and construct alignment. The revised test, named the Lourdes College Aerobic Control Assessment Tool (LC-ACAT), was implemented with 60 college students and facilitated by three implementers. Inter-rater reliability was good to excellent across stages (ICC = 0.750–1.000), with an overall ICC of 0.963. Feedback indicated that the tool was generally practical, clear, and functional, particularly in its structured progression, beat-referenced pacing, and integration of observable and physiological indicators. The LC-ACAT is a three-stage, regulation-based assessment integrating movement continuity, breathing control, pace regulation, and recovery control within a criterion-referenced scoring system. The study concludes that the LC-ACAT is a conceptually grounded and practically applicable tool for assessing aerobic control in PE settings. Further studies may establish its full psychometric properties.

KEYWORDS aerobic control, assessment tool development, physical education, ADDIE model, content validity, pacing regulation

INTRODUCTION

Aerobic control is the ability to monitor and regulate exercise intensity so that physical activity remains within the oxygen-supported energy system, allowing sustained and efficient performance. Aerobic

control is connected with the concept of heart rate zones, the individualized ranges of heart rate that correspond to specific exercise intensity levels and are used to monitor and regulate aerobic activity for optimal cardiovascular benefit and safety (Hrabovska et al., 2023; Iterson et al., 2022; Still et al., 2020). However, the target heart rate zone (THRZ) is not a test; it is a prescriptive and monitoring framework used to guide and regulate exercise intensity during aerobic activity (Hrabovska et al., 2023; Iterson et al., 2022; Still et al., 2020). Such a test is yet to be developed for use in a Physical Education (PE) setting. Moreover, while widely used assessments such as VO_2max testing and the Yo-Yo Intermittent Recovery Test provide valid and reliable measures of aerobic capacity and endurance, they do not directly capture aerobic control as a self-regulatory skill involving the real-time regulation of heart rate, breathing, and exercise intensity during physical activity (Niyazi et al., 2024; Azimkhani et al., 2025; Florian et al., 2024).

Internationally, Gomez and Giang (2024) introduced the term they coined, aerobic control, as the capacity to regulate breathing, heart rate, and exercise intensity during physical activity to sustain efficient physiological functioning and optimize cardiorespiratory health and performance. In essence, it is a self-regulatory skill that integrates physiological awareness and decision-making to optimize endurance, prevent premature fatigue, and ensure safe, effective participation in aerobic activities (Oliveira et al., 2021; Lundstrom et al., 2022). This skill optimizes cardiorespiratory adaptations and also prevents overexertion, promoting long-term health, endurance, and adherence to physical activity (Lundstrom et al., 2022; Zhao et al., 2022). However, international research predominantly operationalizes aerobic functioning through constructs such as aerobic capacity and endurance, commonly measured using VO_2max , ventilatory thresholds, and time-to-exhaustion protocols, rather than directly assessing the self-regulatory processes inherent in aerobic control (Pühringer & Ring-Dimitriou, 2024; Nichols et al., 2021; Niyazi et al., 2024). However, despite its conceptual relevance, there remains no standardized or widely established test in the international literature specifically designed to measure aerobic control as a distinct construct, with existing assessments primarily focusing on aerobic capacity and endurance rather than self-regulatory processes during exercise.

To clear up the conceptual confusion among the terms aerobic capacity, aerobic endurance, and aerobic control, clarification is necessary to ensure conceptual precision and alignment with appropriate measurement practices. Aerobic capacity refers to the *maximal physiological potential* of the body to uptake, transport, and utilize oxygen during intense exercise, commonly quantified through VO_2max , which represents the upper limit or “ceiling” of aerobic performance (Dridi et al., 2021; Hebisz & Hebisz, 2021; Jin et al., 2025). In contrast, aerobic endurance pertains to the *ability to sustain aerobic activity over extended periods*, emphasizing fatigue resistance and prolonged performance at submaximal intensities, typically measured through time-to-exhaustion, distance performance, and lactate threshold indicators (Jin et al., 2025; Kelemen et al., 2025). Distinct from these outcome-based constructs, aerobic control is a *regulatory and process-oriented skill* that involves the real-time monitoring and adjustment of physiological responses—such as heart rate, breathing, and perceived exertion—to maintain exercise within sustainable aerobic limits and optimize performance. Unlike aerobic capacity and endurance, which reflect what an individual *can achieve*, aerobic control reflects how effectively an individual *manages and utilizes* these capacities during actual physical activity (Kelemen et al., 2025; Hebisz & Hebisz, 2021).

Philippine-based PE endurance assessments face notable limitations. Common field tests like the step test and shuttle run, while valid and reliable, are context-dependent and may not reflect the specific endurance needs of Filipino students and athletes (Dimarucot & Macapagal, 2021). Emerging evidence highlights the need for population-specific and context-sensitive assessments, as standardized tools often fail to capture the complexities of endurance, especially when relying on indirect or predictive measures

(Nurhidayah *et al.*, 2024; Chang *et al.*, 2020). These assessments also neglect key components such as pacing and fatigue resistance, despite evidence that fatigue significantly impacts aerobic performance and varies among individuals, and that these factors are now recognized as vital dimensions of endurance (Acar *et al.*, 2025; Daneshgar-Pironneau *et al.*, 2025).

An effort is needed to quantify aerobic control by developing a measurable test, enabling objective assessment of individuals' ability to self-regulate exercise intensity within safe limits (Hrabovska *et al.*, 2023; Iterson *et al.*, 2022; Oliveira *et al.*, 2021). This study aims to create and validate such a test, ensuring it reliably measures physiological self-regulation during aerobic activity. This helps PE teachers shift from outcome-based to process-oriented assessment, focusing on effort, pacing, and physiological responses. Monitoring indicators like heart rate offers a better understanding of engagement and supports individualized, safe, and effective interventions (Solas-Martínez *et al.*, 2025; Sun *et al.*, 2022). The instrument also enables ongoing assessment and real-time adjustments, aligning with learner-centered and outcomes-based education.

This study is relevant to a school in Bukidnon, Philippines, where fitness testing primarily measures endurance and fails to capture the complexity of aerobic control, leaving teachers with limited data for instruction. At the tertiary level, it aligns with the Commission on Higher Education's (2021) policy on Physical Activity Towards Health and Fitness (PATHFit) under CHED Memorandum Order No. 39, s. 2021, which promotes outcomes- and evidence-based approaches, ensuring future educators and coaches have validated tools to assess student fitness. The standardized Aerobic Control Test also supports SDG 3 (Good Health) and SDG 4 (Quality Education).

Anchored in these identified gaps, this research seeks to develop a scientifically and practically grounded instrument to address the lack of standardized measures for aerobic control in both school and athletic contexts. The study emphasizes the psychometric process of instrument development, integrating expert review and content validation to ensure clarity, relevance, and feasibility of the test items.

Moreover, the development and validation of the Aerobic Control Test are anchored in the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), a widely used instructional design framework that provides a structured yet flexible pathway for developing effective learning tools and assessments across face-to-face, online, and blended environments. ADDIE supports the systematic alignment of learner needs, learning outcomes, instructional strategies, and assessment methods, ensuring that instructional decisions are evidence-informed and coherently organized (Ekhsan *et al.*, 2022; Kang & Shon, 2025). Its continued relevance in recent literature is attributed to its ability to guide deliberate planning while still allowing iterative refinement in response to contextual constraints and feedback from actual implementation settings (Hokanson *et al.*, 2022; Leung *et al.*, 2024).

ADDIE applications emphasize that a strong analysis phase improves alignment between content and learner readiness, access to resources, and authentic performance requirements, which ultimately supports stronger engagement and more meaningful outcomes (Hokanson *et al.*, 2022; Millatin & Syukur, 2021).

Within this study, the analysis specifically focuses on aerobic control as a real-life competency, emphasizing how individuals regulate physiological strain during everyday movement and structured exercise. Aerobic control is evident when learners manage activities such as brisk walking, climbing stairs, carrying loads, or maintaining workout intensity by responding to breathing comfort, fatigue signals, and heart rate fluctuations. This phase also examines baseline self-monitoring behaviors (e.g., awareness of resting heart rate and recovery patterns) and recognizes constraints that may reduce exertion tolerance, such

as inconsistent activity routines or post-illness limitations that affect exercise capacity and functional performance (Raman *et al.*, 2021; Venkat *et al.*, 2022).

Building from these contextual observations, the study adopts a conceptual definition of aerobic control as the individual's ability to intentionally regulate breathing and cardiovascular effort through monitoring internal and external cues (e.g., perceived exertion, ventilatory rhythm, and heart rate) and adjusting intensity to match task demands (Gomez & Giang, 2024). This definition highlights aerobic control as a regulation skill centered on pacing and sustaining effort within safe physiological limits, guided by measurable indicators such as resting heart rate patterns and threshold-related responses associated with increasing metabolic strain (Poole *et al.*, 2020; Venkat *et al.*, 2022). With the construct clarified, the study proceeds to the next phase where these insights are converted into an assessment blueprint.

The Design phase translates analysis results into a structured plan that specifies learning objectives, content organization, instructional strategies, and assessment methods. This phase is essential because it ensures coherence between what learners must demonstrate and how performance will be measured, creating a clear architecture for instruction and evaluation (Nurhasanah *et al.*, 2022). Recent ADDIE-based studies further highlight that effective design integrates engagement strategies, interactivity, and performance-based assessments, particularly in digitally mediated environments where learner participation and clarity of outcomes strongly affect success (Anggoro *et al.*, 2024; Suravi, 2023).

In this study, design is operationalized by drafting the Aerobic Control Test as an assessment tool that captures real-world regulation of breathing and heart rate rather than simply measuring endurance capacity. Using the learner characteristics and constraints identified during analysis, the test blueprint defines observable and measurable indicators of aerobic control, such as sustaining a prescribed intensity zone, demonstrating controlled breathing under workload, and adjusting pace when heart rate exceeds the target range. This stage also formalizes the test objectives, procedures, scoring criteria, and interpretation standards, ensuring that assessment outcomes are aligned with the intended construct and can guide individualized instructional decisions and progression. Once the blueprint is established, development focuses on producing and validating the actual instrument.

The Development phase involves producing instructional and assessment materials in accordance with the design specifications, including test protocols, scoring rubrics, and supporting materials. This phase typically includes iterative drafting and internal review to ensure usability, accuracy, and alignment with intended learning outcomes (Irawan *et al.*, 2022). Evidence from digital learning development further emphasizes that quality assurance practices—such as expert review, pilot testing, and refinement—strengthen instructional products by ensuring they remain functional, learner-friendly, and instructionally valid (Braun *et al.*, 2021; Ekhsan *et al.*, 2022).

For the Aerobic Control Test, development is strengthened through content validation, which ensures that the test items, procedures, and scoring criteria adequately represent aerobic control as defined in the conceptual framework. This process confirms that the instrument measures aerobic regulation skills (e.g., pacing, breathing control, and intensity adjustment) rather than unintentionally shifting toward traditional endurance or VO_2max -centered outcomes. Content validation is achieved by convening experts to evaluate clarity, relevance, and completeness of the test components, then quantifying agreement through methods such as the Content Validity Index (CVI) and refining the test based on expert feedback until acceptable content validity is achieved (Dunn *et al.*, 2024; Norshahira *et al.*, 2021). After validation, the instrument is ready for actual administration.

The Implementation phase in this study focuses on the try-out of the revised Aerobic Control Test under standardized conditions to assess its practicality, procedural clarity, and overall usability in actual testing settings. This phase involves preparing test administrators, orienting participants, and setting up logistics (e.g., space, timing systems, and heart-rate monitoring tools), as well as safety monitoring throughout the test administration.

Rather than investigating psychometric properties at this stage, the implementation is intended to observe how well the revised procedures, scoring system, and recording mechanisms function in practice, and to identify any areas requiring further refinement. Implementation quality is strengthened when procedures are closely followed, and participants are guided through structured facilitation and monitoring, particularly in settings where engagement or comprehension challenges may arise (Boespflug, 2022; Sumarmi *et al.*, 2023). In addition, organized systems for recording results and tracking performance contribute to smooth test administration and provide preliminary data that can inform future validation studies (Darmawan *et al.*, 2024).

Following implementation, the Evaluation phase focuses on examining the practical effectiveness, clarity, and functionality of the revised Aerobic Control Test in actual testing conditions. This phase involves reviewing the administration process, including the procedural flow, ease of following instructions, appropriateness of pacing cues, and the usability of the scoring and recording system. Observations from both test administrators and participants are used to identify any difficulties encountered during the test, such as unclear instructions, scoring challenges, or issues related to time, space, and equipment. The evaluation also examines whether the test components—such as breathing control, pacing, movement continuity, and recovery monitoring—can be consistently observed and recorded in real-time. This process is essential for refining the instrument, ensuring that it is practical, understandable, and feasible for use in Physical Education settings (Boespflug, 2022; Sumarmi *et al.*, 2023). Additionally, structured documentation and reflection on the implementation process support continuous improvement of the tool and provide a basis for future studies that may further examine its measurement properties (Darmawan *et al.*, 2024).

Ultimately, evaluation consolidates the evidence needed to finalize the tool and support its use in applied contexts. Once the Aerobic Control Test demonstrates acceptable construct validity, it can be recommended as a standardized assessment for measuring aerobic control in physical education, athletic conditioning, and community fitness programs, providing an evidence-based measure of aerobic regulation and pacing competency that is both scientifically defensible and practically useful.

Statement of the Problem

This study aims to develop, validate, and recommend an Aerobic Control Test for college students by establishing its content validity, inter-rater reliability, and practical usability. Specifically, the study will focus on the following research questions:

1. What aerobic control test can be drafted for college students?
2. What is the feedback of the validators to improve the drafted aerobic control test?
3. Based on validators' feedback, what revisions can be made to the aerobic control test?
4. What is the inter-rater reliability of the aerobic control test?
5. What is the feedback of the implementers on the practical effectiveness, clarity, and functionality of the revised aerobic control test?
6. What aerobic control test may be recommended?

METHODS AND MATERIALS

This study employed a research and development (R&D) design to develop the aerobic control instrument (Borg & Gall, 1989; Tømmerås *et al.*, 2022), guided by the ADDIE framework (Branson *et al.*, 1975; Hokanson *et al.*, 2022). R&D design is appropriate when a study seeks not only to generate knowledge about a problem but also to produce a usable output or artifact that addresses that problem in practice. In this type of design, the research process is organized around identifying a need, grounding the solution in theory and prior evidence, designing and developing the artifact, trying it out in context, and refining it based on feedback and evaluation. As emphasized in design-oriented research, the central outcome of R&D is a tangible product—such as a tool, model, or procedure—supported by systematic inquiry, iterative refinement, and context-based evaluation to ensure relevance, utility, and coherence (Amrollahi & Rowlands, 2018; Teixeira *et al.*, 2019; Tømmerås *et al.*, 2022). This design also allows the integration of multiple sources of evidence and stakeholder feedback, which is essential in developing educational and assessment tools that are both theoretically grounded and practically applicable (Baharmand *et al.*, 2022; Gaglio *et al.*, 2020).

In the context of this study, the R&D design was used to produce a drafted, expert-reviewed, revised, and recommended aerobic control assessment tool for college students. The ADDIE framework provided the stepwise structure for the study: the Analysis phase clarified the problem and the need for a context-sensitive test of aerobic control; the Design phase translated this need into a test blueprint; the Development phase produced the draft instrument and subjected it to expert review and revision; the Implementation phase tried out the revised test in an actual educational setting; and the Evaluation phase examined its practical effectiveness, clarity, and functionality for further refinement. Thus, the study did not merely describe aerobic control as a construct but systematically developed an assessment artifact intended for actual use in Physical Education settings. This makes the R&D design particularly suitable, as it aligns the theoretical goal of defining aerobic control with the practical goal of producing a workable and context-responsive assessment tool.

Purposive sampling was employed in this study, as psychometric validation requires the deliberate selection of participants with characteristics relevant to the construct being measured. The Aerobic Control Test aims to assess the regulation of physiological and perceptual responses during sustained aerobic activity; thus, participants were intentionally selected across different phases to contribute to instrument development, validation, and evaluation.

Five experts with backgrounds in physical education, exercise science, and training participated as key informants in the analysis phase. They had advanced degrees, professional affiliations, and practical experience in areas like exercise testing, aerobic training, and curriculum design. Expert 1 holds a PhD in Physical Education, with experience in sports science and curriculum development, including international projects. Expert 2, also with a PhD, has extensive experience in teaching, coaching, and fitness assessments in colleges. Expert 3, with a master's, specializes in teacher education and sports coaching, merging pedagogical and athletic expertise. Expert 4, a master's degree holder, has experience in sports training and school-based program development, focusing on training structure and performance monitoring. Expert 5, also with a master's, has extensive experience in fitness instruction, wellness programs, and sports development, with a background in community physical activity. Their combined expertise ensured a solid evaluation of the instrument's conceptual and practical aspects.

In the design and development phase, three expert validators with expertise in physical education, sports science, and fitness assessment, including experience in instrument development, teaching, and implementing training programs, were purposively selected to evaluate the drafted Aerobic Control Test. They assessed the test's content validity using the Content Validity Evaluation Form, ensuring relevance, clarity, and feasibility for college-level application. Validator 1 specializes in Physical Education and fitness with secondary education experience; Validator 2, from a higher education institution, has tertiary-level instruction experience; Validator 3, with extensive experience in Physical Education, health, and music, offers expertise in fitness instruction and educational programs. Inclusion of validators from both basic and higher education ensured the instrument's evaluation across diverse settings.

In the implementation and evaluation phase, three (3) implementers led 60 participants, including 30 athletes and 30 non-athletes, from students in PATHFit 2 courses in Bukidnon. Stratified purposive sampling ensured balanced representation of different aerobic fitness levels. Participants had to be at least 20 years old, medically cleared, and willing to participate repeatedly. Inclusion criteria were current PATHFit enrollment, physical readiness, and voluntary consent. Exclusion included medical conditions, inability to complete tests, or refusal of consent. Ethical practices included informed consent, confidentiality, and the right to withdraw.

This study used three tools: a Key Informant Interview Guide for test drafting, a Content Validity Evaluation Form for expert review, and a standardized Aerobic Control Test protocol for psychometric evaluation. The KII Guide gathered expert input on test development, covering domains like background, conceptualization, purpose, design, scoring, feasibility, and recommendations. It identified observable indicators of aerobic control, such as pacing, breathing, heart rate, and exertion, ensuring the test reflects exercise regulation's multidimensional aspects. It also helped identify test components like task type, monitoring tools, and safety criteria, producing a draft blueprint suitable for physical education. The Content Validity Evaluation Form (CVEF) was created to evaluate and refine the Aerobic Control Test through expert judgment using a four-point CVI scale across relevance, clarity, and feasibility, calculating item-level and scale-level CVI. Items rated acceptable (3 or 4) are retained, borderline items revised, and unacceptable ones removed, aligning with the construct. Qualitative feedback from experts on wording, conceptual fit, feasibility, and context supported iterative refinement. The revised test was then administered under standardized conditions to evaluate its inter-rater reliability and practical usability with trained administrators, minimizing errors and ensuring accurate scores.

The data gathering for this study was carefully planned and executed to ensure accuracy, reliability, and ethical compliance. The research design and procedures were approved by the Lourdes College Ethics Committee, and permission was secured from the institution's administration. Participants were recruited based on criteria, and orientation sessions explained the study. The Aerobic Control Test was administered following standardized protocols during validation phases, including expert reviews for content validity, a try-out to evaluate inter-rater reliability and practical usability, with data carefully recorded and analyzed.

Ethical principles from the Belmont Report guided this study, ensuring informed consent, minimizing risks, and fair treatment. Confidentiality was maintained with coded data and secure storage, and findings were reported anonymously. During analysis, experts in physical education, curriculum development, and fitness instruction provided insights, with validation via electronic review.

In the implementation phase, 60 participants (30 athletes, 30 non-athletes) completed the test after institutional approvals. Participants enrolled in a PATHFit course; they recorded resting pulse, warmed up,

and performed the test in three stages—walking, jogging, running—followed by pulse measurements and cool-down for safety.

The data analysis in this study was conducted in three phases corresponding to the three research instruments. For Research Instrument 1 (Key Informant Interview Guide) and the feedback from implementation, qualitative data were analyzed manually. Expert responses and implementers' feedback were also presented as a narrative report. For Research Instrument 2 (Content Validity Evaluation Form), both quantitative and qualitative analyses were employed. Item-level Content Validity Index (I-CVI) values were computed by determining the proportion of experts rating each item as acceptable (ratings of 3 or 4), while scale-level CVI (S-CVI) was calculated as the average of all I-CVI values to assess overall content validity. Decision rules were applied such that items meeting acceptable thresholds were retained, borderline items were revised, and low-rated items were considered for removal. Qualitative feedback was concurrently analyzed to support refinement, clarify ambiguities, and enhance feasibility and construct alignment.

RESULTS

Problem 1. What aerobic control test can be drafted for college students?

In addition, the insights provided by the five experts during the Key Informant Interview in the Analysis phase guided the development of an aerobic control test that emphasizes regulation rather than mere performance outcomes. One of the most consistent points raised was the importance of integrating breathing with movement during aerobic activity.

Table 1 presents a summary of Experts Key Informant Interview (KII) for aerobic control test can be drafted for college students.

Table 1

Summary of Experts of Key Informant Interview (KII) for Draft Aerobic Control Test

Experts	Suggested	Exemplar
Expert 1	Integration of proper breathing with body movement during aerobic activity	"Aerobic control is very important because as you do the aerobics exercise, the proper breathing should go with the movement of your body."
Expert 1	Use of a structured scoring matrix for aerobic control performance	"Introducing the breathing exercise every now and then, at the same time having matrix... on the performance of the aerobics control."
Expert 1	Progressive task design from simple to complex movements	"You should have to introduce them the very basic figures... later on... add more complex figures."
Expert 1	Self-paced or individualized intensity regulation	"It should be individual or self-pace... because not 100% of our learners can learn at the same rate."
Expert 2	Monitoring pulse rate as an objective indicator of aerobic regulation	"I use the 3-minute step test and by just monitoring their pulse rate."
Expert 2	Inclusion of resting, exercise, and recovery pulse measurements	"Resting pulse rate... exercise pulse rate... and recovery pulse rate."
Expert 2	Consideration of BMI and participant safety	"They should also consider their weight, their BMI."
Expert 3	Assessment of coping and stability against fatigue	"The coping and stability... from fatigue."

Expert 4	Use of moderate-intensity aerobic activities	"Measures aerobic capabilities... brisk walk... jumping jacks... high knees."
Expert 5	Progressive stages of walking, jogging, and running	"I would be recommending... walking, jogging, running."
Expert 5	Continuous training as an indicator of good aerobic control	"One indicator that they have good aerobic control is that they are able to do continuous training."

Table 1 organizes the expert recommendations into four key components: breathing regulation, rubric performance, progressive task, and physiological monitoring.

Based on these insights, the drafted Aerobic Control Test (ACT) was designed as a three-stage, progressive, and semi-standardized field-based protocol consisting of walking, jogging, and running tasks. The test is fixed in structure but allows individual regulation of intensity within safe limits, enabling the assessment of aerobic control as a multidimensional construct. It integrates breathing regulation, pacing consistency, movement continuity, and physiological recovery through both observational and physiological indicators, including heart rate response. The inclusion of pre-test screening, staged progression, and real-time monitoring ensures safety, feasibility, and applicability in college Physical Education settings. Overall, the drafted test reflects a direct synthesis of expert insights and empirical evidence, resulting in a theoretically grounded and practically relevant assessment of aerobic control.

Problem 2. What are the feedback of validators to improve the drafted aerobic control test?

Table 2 presents a summary of validators' feedback on the drafted Aerobic Control Test, organized around four key evaluation questions: components to be retained, revised, removed, and added.

Table 2. *Summary of Validators' Feedback on the Drafted Aerobic Control Test and Corresponding Revisions*

Question	Validator	Feedback	Action Taken in Draft 2
1. What parts should be retained?	1	Three-part physiological monitoring (resting, exercise, and recovery pulse) as an objective indicator of regulation and return to homeostasis. Multi-dimensional performance rubric (breathing, pacing, movement continuity) aligned with aerobic control as a regulatory construct. Safety and screening protocols, including pre-test screening and stop criteria.	Retained. The three pulse-rate measurements remain in Monitoring Procedures; the multi-dimensional rubric was kept and further expanded with physiological indicators; pre-test screening and stop criteria were retained verbatim with minor wording refinements ("cardiovascular conditions," "respiratory issues").
	2	Supportive interpretation approach appropriate for college PE settings, emphasizing regulation quality rather than deficit-based labeling. Clear test objectives focusing on aerobic control as a regulatory skill. Three-stage progressive task structure capturing intensity regulation across stages.	Retained. The Excellent-to-Very-Limited descriptors were kept (no "poor" labeling); the Test Purpose was expanded to explicitly state physiological regulation and self-adjustment; the three-stage Walking-Jogging-Running structure was preserved with a note in the draft identifying it as "a strong component."
	3	Inclusion of breathing control, RPE, and recovery components as core indicators. Performance-based scoring rubric emphasizing regulation processes. Overall	Retained. Breathing, RPE (via talk test), and recovery were kept as core indicators and elevated within the rubric; the regulation-focused scoring approach was preserved; minimum equipment, attire, and space requirements were carried over unchanged.

		feasibility of time, space, equipment, and procedures in college settings.	
2. What parts should be revised?	1	Stage 3 intensity should include a defined target intensity zone instead of general pacing, to ensure regulation is assessed under measurable physiological demand.	Acted on. Stage 3 now specifies a target heart-rate zone of 60–75% HRmax, with scoring tied to accuracy of staying within the zone. A note in the draft cites this revision as a direct response to the recommendation that "Stage 3 should include defined intensity targets."
	2	Heart rate measurement must be clearly defined (manual vs. device) and incorporated into scoring. Pacing rules should specify measurable intensity per stage. Breathing regulation should include observable criteria (e.g., rhythmic, synchronized breathing).	Acted on. The How-To Manual specifies manual (radial-pulse 60-s or 15-s × 4) and wearable options; HR is now weighted in the rubric (target accuracy and 1-min recovery drop). Pacing is anchored to beat-referenced tempo (100 BPM walk, 130 BPM jog) and the HRmax-based zone for running. Breathing now has observable indicators: rhythmic breathing, synchronization with movement, and absence of gasping.
	3	Improve the name of the test so that it captures what is being measured. Add step-by-step administrator instructions, structured log sheet, evaluator training guidelines, stage-specific measurement approaches, and reframe fatigue management as control under fatigue rather than endurance capacity.	Acted on. Test renamed from Aerobic Control Test (ACT) to Lourdes College Aerobic Control Assessment Tool (LC-ACAT) . A full How-To Manual with timing, cues, and commands was added; a standardized Recording Sheet was developed; dual-protocol framework (small-group evaluator-based and large-group self-assessment) standardizes evaluator roles. Indicators are now stage-specific (observable for Stages 1–2; talk test and HR for Stage 3). Fatigue Management was absorbed into "Movement Continuity and Regulation," reframing it as control under fatigue rather than endurance.
3. What parts should be removed?	1	Overemphasis on task completion (e.g., continuous 9-minute activity) should be reduced, as completion alone does not reflect quality of regulation.	Acted on. The Type of Test description was rewritten from completion-oriented language ("complete the same stages") to "regulated intensity control" focused on how well students control breathing, pacing, and effort. The accompanying revision note explicitly states the shift "from completion to quality of regulation."
	2	Scoring based on duration or uninterrupted performance alone should be minimized.	Acted on. The rubric no longer rewards mere continuous movement; the Movement Continuity criterion was renamed Movement Continuity and Regulation, with anchors that explicitly score how movement is adjusted under fatigue, not whether the student lasted the full duration.
	3	Implicit endurance bias in scoring and interpretation should be removed.	Acted on. The standalone Fatigue Management criterion (which favored fit individuals) was eliminated, criteria were reduced from five to four, Part A maximum was adjusted from 25 to 20, and the Interpretation Guide was recalibrated using a criterion-referenced, equal-interval framework rather than endurance-based norms.
4. What should be added?	1	Mid-stage pacing correction to assess real-time self-regulation. Talk test integration as a practical proxy for breathing control.	Acted on. A mid-stage cue ("Check your breathing and pace") was added at minute 2 of every stage, requiring students to adjust in real time. A Talk Test was added at the end of each stage, formally scored at Stage 3 (full sentence = 5, single words = 2, unable = 1).
	2	Target heart rate zones with scoring based on accuracy of regulation. Self-regulation/reflection component. Optional wearable HR monitoring. Integration of physiological indicators (HR and recovery) with observational scoring.	Acted on. Target HR zone (60–75% HRmax) added with scored accuracy bands. Self-regulation is operationalized through mid-stage cues and through a Self-Assessment step in the large-group protocol with evaluator validation of 20–30% of participants. Wearable HR monitor is listed as optional equipment. Recording Sheet integrates observational ratings and physiological values (HR target

		accuracy and 1-min recovery drop) into a single 50-point scoring scheme.
3	Development of explicit "how-to" procedures and observable scoring anchors. Inclusion of structured recording and documentation systems.	Acted on. A complete How-To Manual was added covering setup, familiarization, resting HR measurement, warm-up, stage-by-stage administration, rest intervals, scoring application, safety, and time/group management. Each rubric level (1-5) now has an operational definition with concrete behavioral anchors. A standardized Recording Sheet with stage-specific indicators, 1-5 score boxes, beat-referenced tempo cues, and a notes/remarks column was introduced.

Table 2 presents the consolidated validators' feedback on the improvement of the drafted Aerobic Control Test, organized into four major domains: components to be retained, revised, removed, and added. The table indicates that several core elements were affirmed as strong foundations of the test, particularly the integration of physiological monitoring (resting, exercise, and recovery pulse), the use of a multidimensional performance rubric encompassing breathing, pacing, and movement continuity, and the inclusion of safety protocols and feasibility considerations. These components were viewed as consistent with the conceptualization of aerobic control as a regulation-based construct. However, the validators identified the need for substantial revisions to improve construct alignment, including specifying intensity targets, integrating physiological data into scoring, clarifying pacing and breathing indicators, and developing standardized administration and recording procedures.

In addition, certain elements were recommended for removal or reframing, particularly those that emphasized endurance or task completion, as they were found to misrepresent the intended construct of regulation. Finally, the validators suggested several enhancements, such as the inclusion of mid-stage adjustments, talk test measures, target heart rate zones, and structured "how-to" procedures, to strengthen the measurement of pacing, breathing control, and physiological regulation. Overall, the table reflects a shift from a performance-oriented assessment toward a more comprehensive, standardized, and regulation-focused instrument.

Moreover, Table 3 presents the results of the initial content validity analysis of the draft Aerobic Control Test using the Item-Level Content Validity Index (I-CVI) based on validators' ratings.

Table 3. *Item-Level Content Validity Index (I-CVI) of the Aerobic Control Test Draft*

Item Code	Test Component (Draft)	Ratings	I-CVI	Decision
R1	Test objective reflects aerobic control (regulation skill)	3/3	1.00	Retain
R2	Test task/activity elicits pacing + intensity regulation	3/3	1.00	Retain
R3	Heart rate monitoring indicator is appropriate	3/3	1.00	Retain
R4	Breathing regulation indicator is appropriate	3/3	1.00	Retain
R5	Perceived exertion (RPE/talk test) indicator is appropriate	2/3	0.67	Revise
R6	Test procedure matches real-life aerobic demands	3/3	1.00	Retain

Item Code	Test Component (Draft)	Ratings	I-CVI	Decision
R7	Scoring criteria reflect aerobic control (not endurance only)	3/3	1.00	Retain
R8	Interpretation categories are meaningful for college students	3/3	1.00	Retain*
R9	Recovery component reflects aerobic control outcomes	3/3	1.00	Retain
R10	Test outcomes are aligned with intended use (PE/fitness)	3/3	1.00	Retain
C1	Instructions for participants are clear	3/3	1.00	Retain
C2	Instructions for test administrators are clear	3/3	1.00	Retain
C3	Warm-up procedures are clearly stated	3/3	1.00	Retain
C4	Pacing rules are clearly stated	3/3	1.00	Retain
C5	Heart rate measurement procedure is clear	3/3	1.00	Retain
C6	Breathing cues/standards are clear	2/3	0.67	Revise
C7	Scoring steps are clear and easy to apply	3/3	1.00	Retain
C8	Interpretation guide is clear for decision-making	3/3	1.00	Retain
C9	Stop criteria are clearly explained	3/3	1.00	Retain
C10	Recording sheet/log format is clear	3/3	1.00	Retain
F1	Time requirement is realistic for class testing	3/3	1.00	Retain
F2	Space requirement is realistic for campus facilities	3/3	1.00	Retain
F3	Equipment required is accessible and practical	3/3	1.00	Retain
F4	Procedures are manageable for instructors	3/3	1.00	Retain
F5	Scoring workload is manageable	3/3	1.00	Retain
F6	Protocol can be standardized across testers	2/3	0.67	Revise
F7	Test is safe for mixed fitness levels	3/3	1.00	Retain
F8	Test is appropriate for non-athlete populations	3/3	1.00	Retain

It should be noted that this content validation procedure was administered to the draft of the aerobic control test to improve the test. The Scale-Level Content Validity Index (S-CVI/Ave) for this draft was 0.96; this value is reported as a preliminary baseline and should be interpreted with caution given the test's developmental status. At the item level, the majority of components demonstrated perfect agreement among validators, with 25 of 28 items achieving an I-CVI of 1.00, indicating that all validators rated these items as acceptable (ratings of 3 or 4). These items span key components across relevance (R1–R4, R6–R10), clarity (C1–C5, C7–C10), and feasibility (F1–F5, F7–F8), suggesting strong content representation, clear procedures, and

practical implementation. These results indicate that the core structure of the Aerobic Control Test is well aligned with the construct of aerobic control and clearly defined for application in a college setting.

However, three items—R5 (perceived exertion indicator), C6 (breathing cues), and F6 (protocol standardization)—obtained an I-CVI of 0.67, indicating that only two out of three validators rated these items as acceptable. Based on standard decision rules, these items were marked for revision, suggesting the need to improve their clarity, operational definition, or alignment with the construct. Specifically, these results suggest that integrating perceived exertion, specifying observable breathing indicators, and standardizing testing protocols require further refinement to enhance consistency and interpretability.

Problem 3. Based on validators' feedback, what revisions can be made to the aerobic control test?

An annotated revision process of the researcher documents the systematic transformation of the Aerobic Control Test from its initial draft into a revised, regulation-based assessment tool, highlighting specific changes made in response to expert feedback. The first major revision redefined the test purpose and construct: aerobic control was expanded to explicitly include physiological regulation, self-adjustment, and recovery processes rather than merely sustaining activity, and physiological regulation—particularly heart rate—was formally incorporated as a core component. A second major revision shifted the assessment logic from endurance-based to regulation-based: elements such as fatigue management and continuous task completion were reframed, fatigue was recast as control under fatigue, and the emphasis shifted toward how participants regulate breathing, pacing, and movement across progressively demanding stages. The third revision integrated and quantified physiological indicators in the scoring system: heart rate measures, initially treated as supporting data, were embedded into the rubric through target heart rate zones and recovery metrics, so that heart rate now directly contributes to scoring.

Moreover, measurement indicators were operationalized more precisely through observable, behaviorally anchored criteria—including rhythmic breathing patterns, beat-referenced pacing (beats per minute, BPM), and the talk test—and the scoring rubric was redesigned with explicit 1–5 descriptors and operational definitions. A stage-sensitive measurement framework was introduced, using observational indicators in the lower-intensity stages (walking and jogging) and physiological and structured measures in the higher-intensity stage (running). Protocol standardization and administration procedures were improved with structured timing cues, pacing references, and detailed how-to instructions, and both small-group (evaluator-based) and large-group (self-assessment-supported) protocols were developed. A standardized recording sheet was developed to organize performance and physiological indicators across stages and to provide anchored scoring options.

Further, the interpretation guide was revised to a criterion-referenced, regulation-based framework: score ranges were recalibrated to equal intervals and descriptors were aligned with levels of regulation (e.g., highly regulated, effective regulation). The instrument was renamed the Lourdes College Aerobic Control Assessment Tool (LC-ACAT), following the convention of naming tools after their institution of origin (e.g., the Harvard Step Test, Queen's College Step Test, and YMCA 3-Minute Step Test). Overall, the revisions documented produced an instrument that is conceptually aligned, operationally clear, physiologically grounded, and practically feasible.

Problem 4. What is the inter-rater reliability of aerobic control test?

Table 4 presents the inter-rater reliability of the Aerobic Control Test across the walking, jogging, and running stages, as well as the overall total score, using Intraclass Correlation Coefficients (ICCs).

Table 4. Inter-Rater Reliability of the Aerobic Control Test

Stage	ICC Type	ICC Estimate	95% CI	Interpretation
Walking Stage	ICC(3,k)	0.750	0.616–0.843	Good reliability
Jogging Stage	ICC(3,k)	1.000	1.000–1.000	Excellent reliability
Running Stage	ICC(3,k)	0.822	0.726–0.888	Good reliability
Overall Total Score	ICC(3,k)	0.963	0.943–0.977	Excellent reliability

Note. Based on 60 subjects and 3 raters/measurements. ICC type was reported as ICC(3,k), following Shrout and Fleiss (1979). Results show that the Aerobic Control Test demonstrated good to excellent inter-rater reliability across stages, with the overall total score showing excellent agreement among raters.

The results indicate that the Aerobic Control Test demonstrates good to excellent inter-rater reliability across all stages. The walking stage yielded an ICC of 0.750 (95% CI: 0.616–0.843), indicating good agreement among raters, while the jogging stage achieved a perfect ICC of 1.000, reflecting excellent and consistent scoring across evaluators. The running stage also showed good reliability with an ICC of 0.822 (95% CI: 0.726–0.888). Notably, the overall score yielded an ICC of 0.963 (95% CI: 0.943–0.977), indicating excellent reliability and high consistency across ratings when all components are considered together. These findings suggest that the Aerobic Control Test yields stable, consistent scores across raters, supporting its reliability as an assessment tool.

The inter-rater reliability was calculated from the three raters' scores using the LC-ACAT recording sheet. Each rater scored the same 60 respondents using the same 1–5 rubric indicators. For Stage 1, raters scored three components: Movement Continuity and Regulation, Breathing Control, and Pace Regulation, giving a stage subtotal of 15 points. The same scoring structure was used for Stage 2, also with a maximum of 15 points. For Stage 3, raters scored Movement Continuity and Regulation, Breathing Control, Pace Regulation, and Recovery Control, giving a subtotal of 20 points. These stage subtotals were then combined to generate the overall total score out of 50 points for each respondent per rater.

Using these scores, the Intraclass Correlation Coefficient ICC(3,k) was computed to determine the degree of agreement among the three raters. ICC(3,k) was appropriate because the same fixed set of raters evaluated all respondents, and the reliability estimate was based on the average rating across raters. Separate ICC values were computed for the Stage 1 subtotal, Stage 2 subtotal, Stage 3 subtotal, and the overall total score. Thus, the reliability analysis examined whether the three raters assigned consistent scores when applying the LC-ACAT rubric across each stage and across the full assessment.

Problem 5. What is the feedback of the implementers on the practical effectiveness, clarity, and functionality of the revised aerobic control test?

The feedback from the implementers indicates that the revised LC-ACAT was generally practical, clear, and functional during the try-out, with only minor challenges related to group management and specific procedures. In terms of practical effectiveness, all implementers described the test as manageable and feasible within a Physical Education setting. One implementer noted that “the implementation of the LC-ACAT was smooth and manageable... the progression from walking to running was easy to facilitate” (Implementer 1), while another emphasized that “the flow felt natural... organized and manageable” (Implementer 2). The structured progression of stages and minimal equipment requirements contributed to its practicality. The use of beat-referenced pacing was also highlighted as a major strength, with one implementer stating that “the beat-referenced pacing system helped maintain uniformity” (Implementer 1) and another noting that “the pacing [was] super easy for the participants” (Implementer 2). However, a recurring concern was the challenge

of handling large groups, as monitoring multiple participants simultaneously became demanding, particularly during higher-intensity stages. As one implementer explained, *“keeping track of individual performance... became slightly demanding”* (Implementer 3), suggesting the need for additional evaluators or smaller group sizes.

In terms of clarity, the implementers consistently reported that the instructions and procedures were generally easy to understand and follow. Instructions related to pacing, movement, and warm-up were described as *“simple and clear”* (Implementer 2), and most students were able to follow them with minimal clarification. However, specific components required further reinforcement. The Talk Test and recovery heart rate procedures were identified as areas needing clearer explanation or demonstration. One implementer observed that *“some students needed more demonstration for the Talk Test portion”* (Implementer 1), while another noted that *“many students were not familiar with how to properly locate and count their pulse”* (Implementer 3). Additionally, transitions between stages could be improved through stronger cues, as suggested by the observation that transitions *“could be signaled more strongly so students don’t get confused”* (Implementer 2). These findings indicate that while the overall structure is clear, certain technical components require additional instructional support.

Regarding functionality, the results show that the core components of the LC-ACAT effectively worked together to assess aerobic control during actual implementation. Implementers consistently reported that breathing, pacing, and movement indicators were observable and functional, with one noting that *“breathing, pacing, and movement indicators functioned well”* (Implementer 1). The Talk Test, in particular, was identified as a valuable feature, as it *“really helped distinguish levels of breathing control”* (Implementer 2) and served as a *“simple yet reliable indicator of aerobic intensity”* (Implementer 3). The integration of multiple indicators allowed for a comprehensive assessment of performance. However, heart rate monitoring remained a challenge, as students required assistance in accurately checking their pulse, with one implementer stating that *“students needed guidance checking their pulse accurately”* (Implementer 1). Similarly, scoring and recording were generally manageable but became demanding in large-group contexts, where *“monitoring several indicators at once... felt a bit fast-paced”* (Implementer 2).

Overall, the implementers’ feedback suggests that the revised LC-ACAT is practical, understandable, and functional, with strong potential for use in Physical Education settings. The identified areas for improvement—particularly in heart rate monitoring, instructional reinforcement, and large-group implementation—provide actionable directions for further refinement of the tool.

Problem 6. What aerobic control test may be recommended?

The study recommends the Lourdes College Aerobic Control Assessment Tool (LC-ACAT) as a regulation-based instrument for assessing aerobic control among college students. The LC-ACAT is a three-stage progressive assessment consisting of walking, jogging, and running, designed to evaluate individuals’ ability to regulate breathing, pacing, movement continuity, physiological responses, and recovery across increasing levels of intensity. The instrument integrates both observational indicators (e.g., rhythmic breathing, movement control, and beat-referenced pacing) and physiological measures (e.g., heart rate target accuracy and 1-minute recovery response) within a structured 1–5 rubric system across four domains: movement continuity and regulation, breathing control, pace regulation, and recovery control. The test is criterion-referenced, with a total score ranging from 10 to 50, supported by an interpretation guide that classifies levels of aerobic control from very limited to excellent.

In addition, the LC-ACAT includes standardized administration procedures, dual testing protocols (small-group and large-group formats), and a structured recording sheet to ensure consistency, clarity, and

feasibility. The test can be administered in approximately 25–30 minutes per batch and is designed for use in college Physical Education settings among both athlete and non-athlete populations.

DISCUSSION

The findings are interpreted below in relation to the study's theoretical framework and the broader literature on aerobic regulation and instrument development, following the same questions addressed in the Results.

Drafting the Aerobic Control Test

In the Philippines, tertiary physical education was substantively reanchored by the Commission on Higher Education through Memorandum Order (CMO) No. 39, Series of 2021, which prescribes the Physical Activity Towards Health and Fitness (PATHFIT) courses and reorients college PE from skill- and sport-driven instruction toward a health- and lifelong-fitness model built on two program outcomes – Active and Healthy Living and Advocacy and Action (CHED, 2021). Implementation studies across Philippine state universities have shown that PATHFIT can meaningfully improve students' cardiorespiratory and muscular fitness, but they have also surfaced persistent gaps: uneven curriculum alignment, inconsistent fitness-testing practices, and teacher uncertainty about how to operationalize health-related assessment within the new framework (Aquino, 2023; Dimarucot *et al.*, 2024; Tolentino & Sinio, 2024). These gaps are consequential because Filipino college students continue to report moderate-to-low fitness profiles and reduced physical-activity engagement upon entry into higher education, echoing the broader generational decline noted among tertiary learners in the country (Catalan *et al.*, 2024; Tagare, 2022). Within this policy and practice context, a defensible aerobic assessment is needed not only as evidence of PATHFIT learning outcomes but also as a pedagogical tool to guide subsequent course design.

Existing aerobic protocols used in Philippine PATHFIT classrooms – most notably the 3-minute Step Test adopted in many institutional batteries – privilege terminal indicators such as recovery heart rate, distance, or estimated VO_2max , and largely leave unmeasured the regulatory behaviors that sustain aerobic performance (Dimarucot *et al.*, 2024). Contemporary exercise science, however, conceptualizes aerobic performance as a self-regulated process in which the brain integrates physiological, interoceptive, and perceptual signals to modulate effort and prevent premature fatigue, consistent with the Central Governor Model and its anticipatory-feedback extensions (Ferraz *et al.*, 2022; Palacin *et al.*, 2024; Poinard *et al.*, 2024). This regulatory dimension – encompassing breathing coordination, pacing, perceived exertion, and recovery – is precisely the lifelong-fitness capability that PATHFIT seeks to cultivate, yet it is rarely captured by conventional college-level testing. Drafting an aerobic control test that explicitly captures this regulatory construct, therefore, requires not only literature-derived principles but also the practical, experience-based judgment of seasoned PE practitioners working under CMO 39, which provided the rationale for the Key Informant Interview that follows.

The expert recommendations summarized in Table 1 are strongly supported by existing literature, which conceptualizes aerobic control as a multidimensional regulatory process integrating physiological, perceptual, and cognitive mechanisms during exercise (Poinard *et al.*, 2025; Palacin *et al.*, 2024). The emphasis on breathing coordination aligns with evidence that interoceptive signals such as breathing and perceived exertion play a central role in regulating exercise intensity and sustaining performance (Ávila-Gandía *et al.*, 2020; Butterworth *et al.*, 2025). The use of structured rubrics reflects the need for assessment systems that capture regulatory behaviors such as pacing and effort modulation, the staged progression and moderate-intensity tasks are consistent with established principles of progressive aerobic testing (Costa *et*

al., 2021; Bento *et al.*, 2021), and the integration of heart rate monitoring is supported by its widespread use as a valid, practical indicator of aerobic response and recovery (Krause *et al.*, 2024; Silva *et al.*, 2021).

The recommendation to allow self-paced performance is particularly significant, as research shows that self-regulated exercise protocols provide higher ecological validity by enabling individuals to adjust intensity based on internal cues (Chia & Marino, 2023; Hyland-Monks *et al.*, 2022). This aligns with theories of central regulation, which suggest that the body continuously modulates effort to maintain homeostasis and prevent excessive fatigue (Poinsard *et al.*, 2025; Konings & Hettinga, 2020). The inclusion of fatigue management as part of aerobic control is also supported by literature identifying fatigue perception as a key determinant of endurance performance and regulation (Sun, 2025). Moreover, combining observational assessment with time-based and physiological measures reflects a multimodal approach recommended in exercise science to capture both behavioral and physiological dimensions of performance (Krause *et al.*, 2025). Finally, considerations of participant characteristics, safety, and developmental appropriateness align with best practices in fitness assessment, ensuring that the test is both valid and applicable within educational contexts (Costa *et al.*, 2021).

Validators' Feedback and Content Validity

The validators' feedback summarized in Table 2 is strongly supported by contemporary theoretical and empirical literature on aerobic regulation and assessment. The emphasis on retaining multidimensional indicators—such as breathing, pacing, and recovery—aligns with the Central Governor Model, which posits that exercise performance is regulated through continuous integration of physiological signals, perceptual feedback, and cognitive processes to maintain homeostasis and prevent excessive fatigue. This supports the inclusion of both physiological measures (e.g., heart rate and recovery) and perceptual indicators (e.g., breathing control and exertion), as aerobic control is not a unidimensional construct but an interaction of internal and external regulatory mechanisms (Poinsard *et al.*, 2025; Hyland-Monks *et al.*, 2022).

The recommendation to revise the test by integrating physiological data into scoring and specifying intensity targets is consistent with literature emphasizing the importance of objective internal load indicators, such as heart rate, in accurately assessing exercise regulation (Krause *et al.*, 2024; Silva *et al.*, 2021). In particular, the use of target heart rate zones provides a quantifiable benchmark for pacing regulation, reducing reliance on subjective judgment and enhancing measurement validity. Similarly, the refinement of breathing indicators using observable criteria and the integration of the talk test reflect established approaches in exercise physiology, in which respiratory responses serve as practical proxies for ventilatory control and exertion levels.

The removal of endurance-oriented components further aligns with research highlighting that traditional aerobic tests often conflate capacity and endurance with control (regulation), leading to construct contamination (Chia & Marino, 2023). By shifting the focus from task completion and duration toward the quality of pacing, breathing, and movement regulation, the revised test better captures the dynamic processes underlying aerobic control. This is supported by studies indicating that self-regulated and perceptually guided exercise tasks provide more ecologically valid insights into how individuals manage effort and fatigue in real time (Smith *et al.*, 2024).

Moreover, the addition of mid-stage pacing adjustments, self-regulation components, and structured protocols reflects the growing emphasis on self-regulation theory in physical activity, which views exercise performance as an adaptive process involving continuous monitoring and adjustment of internal states (Chia & Marino, 2023). The incorporation of these elements enhances the ecological validity of the test by simulating real-world exercise conditions where individuals must actively regulate their performance.

Finally, the call for standardized procedures, structured recording systems, and evaluator guidelines is well supported by psychometric literature, which underscores that clarity, standardization, and operational precision are essential for ensuring reliability and validity in instrument development (Amiri-Farahani *et al.*, 2021; Tseli *et al.*, 2023). Without such standardization, variability in administration and scoring can introduce measurement error, thereby undermining the instrument's credibility.

The findings align with methodological literature emphasizing that content validity is a critical first step in instrument development, ensuring that items adequately reflect the intended construct before proceeding to further validation stages (Amiri-Farahani *et al.*, 2021; Tseli *et al.*, 2023). In the context of this study, the strong agreement across items related to pacing, breathing, recovery, and physiological monitoring supports the theoretical framing of aerobic control as a multidimensional regulatory process, rather than a unidimensional measure of endurance. This is consistent with contemporary exercise science literature, which highlights that aerobic performance is governed by the interaction of physiological, perceptual, and cognitive processes that regulate effort and maintain homeostasis (Poinsard *et al.*, 2025; Hyland-Monks *et al.*, 2022). The retention of most items, therefore, reinforces that the drafted test successfully captures these essential regulatory dimensions.

However, the items identified for revision (R5, C6, and F6) highlight important nuances in the operationalization of complex constructs such as aerobic control. The lower I-CVI for perceived exertion (R5) suggests that, although RPE is theoretically recognized as a valid indicator of internal load, its integration into scoring must be clearly defined and contextually appropriate (Krause *et al.*, 2024; Silva *et al.*, 2021).

Similarly, the need to refine breathing cues (C6) reflects the challenge of translating internal physiological processes into observable, measurable indicators, a concern noted in both the exercise and measurement literature, where clarity of operational definitions is essential for consistent assessment (Hyland-Monks *et al.*, 2022). The revision required for protocol standardization (F6) further aligns with psychometric principles, emphasizing the need for standardized administration procedures and evaluator training to minimize measurement error and ensure reliability across testing conditions (Amiri-Farahani *et al.*, 2021; Tseli *et al.*, 2023).

Revising the Instrument

The revisions align with contemporary views of exercise regulation that integrate physiological, perceptual, and cognitive mechanisms to maintain homeostasis (Poinsard *et al.*, 2025; Hyland-Monks *et al.*, 2022). Reframing fatigue as control under fatigue is consistent with the view that aerobic performance is the dynamic regulation of effort and physiological responses rather than mere output capacity (Chia & Marino, 2023). Embedding heart rate into scoring through target zones and recovery metrics follows research emphasizing the combination of internal load indicators with observable behaviors for valid assessment of exercise regulation (Krause *et al.*, 2024; Silva *et al.*, 2021), while the behaviorally anchored breathing, pacing, and talk-test criteria and the 1–5 operational descriptors align with psychometric principles requiring clear, observable indicators for consistent measurement (Amiri-Farahani *et al.*, 2021; Tseli *et al.*, 2023). The stage-sensitive framework, dual administration protocols, standardized recording sheet, and criterion-referenced interpretation guide reflect best practices for scalable yet standardized assessment. Collectively, the transformation reflects adherence to both exercise science theory and psychometric principles, ensuring that the final tool validly measures aerobic control as a multidimensional regulatory process.

Inter-Rater Reliability

Literature on instrument development stresses that clarity of indicators, scoring structure, and administration protocols helps minimize measurement error and improve reliability (Amiri-Farahani *et al.*, 2021; Tseli *et al.*, 2023). Moreover, because aerobic control involves the integration of physiological, perceptual, and behavioral regulation, the use of multiple scored components across stages is appropriate for capturing the construct more comprehensively (Poinsard *et al.*, 2025; Hyland-Monks *et al.*, 2022). Therefore, the inter-rater reliability results provide evidence that the LC-ACAT can be scored with acceptable consistency when administered using standardized procedures and trained raters.

Implementer Feedback

These findings are consistent with existing literature on physical fitness assessment, which emphasizes that effective tools must balance feasibility, clarity, and functional integration to be applicable in real-world educational settings (Costa *et al.*, 2021). The positive feedback on structured progression and pacing aligns with research supporting staged aerobic protocols as practical and safe for diverse populations (Bento *et al.*, 2021). The effectiveness of beat-referenced pacing and the Talk Test further supports the use of observable and perceptual indicators in regulating exercise intensity, which have been shown to enhance ecological validity and participant engagement (Chia & Marino, 2023; Hyland-Monks *et al.*, 2022).

At the same time, the challenges related to group size, scoring demands, and heart rate monitoring reflect common issues in field-based assessments, where logistical constraints and participant skill levels can affect implementation (Krause *et al.*, 2024; Silva *et al.*, 2021). The need for demonstration, guided practice, and additional facilitators is also supported by literature emphasizing the importance of clear instructional scaffolding and standardized procedures to ensure consistency and accuracy in performance-based assessments (Amiri-Farahani *et al.*, 2021; Tseli *et al.*, 2023).

The Recommended Instrument and Its Limitations

The recommendation of the LC-ACAT is supported by both the revision process and the relevant literature, which emphasizes aerobic control as a multidimensional regulatory process. The high content validity index obtained from the draft version ($S-CVI/Ave = 0.96$) serves as a baseline indicator of the instrument's conceptual strength, demonstrating strong expert agreement on the relevance, clarity, and feasibility of its core components. Subsequent revisions further refined the test by improving construct alignment, operational clarity, and standardization, particularly by integrating physiological indicators into scoring, developing observable measurement criteria, and implementing structured protocols.

This aligns with contemporary exercise science literature, which highlights that aerobic performance involves continuous regulation of physiological and perceptual responses to maintain homeostasis, rather than merely sustaining activity (Poinsard *et al.*, 2025; Chia & Marino, 2023). The integration of heart rate monitoring, recovery dynamics, and behavioral indicators in the LC-ACAT reflects this regulatory perspective and supports its construct validity.

The present study primarily focused on the development of the Lourdes College Aerobic Control Assessment Tool (LC-ACAT), with emphasis on establishing its conceptual framework, design structure, and content alignment based on expert feedback. As such, the psychometric evaluation was limited to baseline content validation procedures, while other forms of psychometric validation were not fully implemented at this stage. This approach is consistent with standard practices in instrument development, where content validation serves as an initial step before more advanced psychometric testing is conducted (Amiri-Farahani *et al.*, 2021; Tseli *et al.*, 2023). This limitation is acknowledged, considering the researcher's timeline and

capacity. Furthermore, these additional validation procedures, essential to establishing the tool's measurement properties, are recommended for future studies to ensure methodological rigor and broader applicability.

In addition, the construct validity of the LC-ACAT is theoretically supported but not yet empirically established, as the current study was not designed to conduct correlational or comparative validation analyses. The instrument was developed to measure aerobic control as a latent, multidimensional construct encompassing physiological, perceptual, and behavioral regulation. This conceptualization aligns with the Central Governor Model, which posits that exercise performance is regulated by the interaction between physiological signals and perceptual feedback to maintain homeostasis (Poinsard *et al.*, 2025; Hyland-Monks *et al.*, 2022). While the integration of heart rate, breathing control, and pacing indicators aligns with this theoretical framework, empirical validation through convergent and discriminant analyses is recommended for future research. Thus, the findings of this study should be interpreted in the context of instrument development, with the LC-ACAT as a theoretically grounded, expert-informed tool that requires further validation to establish its full psychometric properties.

Furthermore, to ensure the protection, proper attribution, and controlled use of the developed instrument, it is recommended that the Lourdes College Aerobic Control Assessment Tool (LC-ACAT) be formally registered for copyright. As an original assessment tool, the LC-ACAT qualifies as an intellectual property under applicable copyright laws, which protect literary and instructional works, including test manuals, scoring systems, and accompanying materials. Securing copyright will establish the developers' authorship and prevent unauthorized reproduction, modification, or distribution of the instrument.

Furthermore, copyright registration supports ethical dissemination by allowing the developers to define terms of use, such as requiring permission for adoption, adaptation, or publication. This is particularly important for maintaining the integrity and standardized application of the test across different settings. In addition, formal recognition of the LC-ACAT as a copyrighted tool enhances its credibility and potential for institutional adoption, aligning with best practices in the development and dissemination of educational and fitness assessment instruments.

CONCLUSION

This study successfully achieved its primary purpose of developing a contextually grounded and theoretically informed Aerobic Control Test, culminating in the recommended Lourdes College Aerobic Control Assessment Tool (LC-ACAT). Through a systematic research and development process anchored on the ADDIE framework, the study was able to draft, refine, and implement an assessment tool that captures aerobic control as a multidimensional regulatory construct, rather than a purely performance- or endurance-based outcome. The integration of expert input, content validation procedures, and try-out implementation ensured that the instrument is both conceptually aligned and practically applicable in Physical Education settings.

Despite these contributions, the study has several limitations. First, the research primarily focused on test development and initial refinement, with limited emphasis on comprehensive psychometric validation. While content validity and inter-rater reliability were established, other properties such as construct validity were not fully examined. Second, the implementation was conducted within a single institutional and geographic context, which may limit the generalizability of findings. Third, practical challenges such as large-group administration, participants' unfamiliarity with heart rate monitoring, and the need for additional evaluator support were identified, indicating areas requiring further procedural refinement.

Notably, this study contributes significantly to both knowledge and practice by operationalizing aerobic control as a measurable construct and developing a tool that integrates physiological, behavioral, and perceptual indicators within a single assessment framework. The shift from endurance-based testing to regulation-based assessment is a key conceptual advancement, aligning with contemporary perspectives in exercise science that emphasize self-regulation, pacing, and physiological awareness. In practice, the LC-ACAT provides Physical Education teachers and practitioners with a feasible, structured, and instructionally relevant tool that supports process-oriented assessment, promotes safe and individualized engagement in exercise, and enhances learners' understanding of their own physiological responses. Overall, the study establishes a strong foundation for future research and application, highlighting the need for continued validation, wider implementation, and further refinement to fully realize the potential of aerobic control assessment in educational and fitness contexts.

Future researchers may conduct further psychometric validation of the LC-ACAT by examining construct validity (e.g., convergent and discriminant validity) and additional reliability evidence using larger, more diverse samples. Comparative studies with established fitness assessments may also be undertaken to strengthen empirical support. Expanding the study across multiple institutions and contexts may improve the instrument's generalizability and applicability. Moreover, Physical Education teachers may consider initially implementing the LC-ACAT in small-group formats (e.g., 1:5 ratio) before applying it in larger class settings. Providing orientation and guided practice, particularly in pulse checking, pacing using beat-referenced cues, and the Talk Test, may help improve the accuracy of performance and scoring. The tool may also be used formatively to support students' development of self-regulation skills during physical activity.

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Conflict of Interest: The author declares that there is no conflict of interest regarding the publication of this article.

Acknowledgements: The researcher extends his sincere gratitude to Almighty God for His wisdom and grace, to his thesis mentor, professors, and panellists for their invaluable guidance and support, and to his family and loved ones for their unwavering love and encouragement, to whom all glory is humbly offered.

Funding: This research received no external funding and was supported solely by the personal resources of the primary author.

Ethical Approval: The study was reviewed and approved by the Ethics Committee of Lourdes College, Inc., the researcher's academic institution, in accordance with the ethical standards outlined in the Belmont Report. Informed consent was obtained from all participants, ensuring full ethical compliance.

AI Declaration: This study utilized artificial intelligence tools to assist in preparing this article. Specifically, ChatGPT was used to convert the full thesis manuscript into a reduced journal article format, with human supervision and editing, to ensure academic rigor and integrity. Additionally, ChatGPT and Grammarly AI were used to enhance the language quality, clarity, and tone of the final manuscript. The author carefully reviewed and edited all outputs to maintain scholarly standards.

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. Requests for access will be evaluated in accordance with ethical guidelines and data privacy policies.