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Developing an Instrument to Assess Physical Education Teachers' Competencies in Using Fitness Monitoring to Promote Physical Literacy

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Abstract: Background: Physical education teacher (PET) competences are crucial for developing students' physical literacy. To support holistic student growth and lifelong physical activity, teachers need skills like using fitness monitoring as an educational tool. This study aimed to create an instrument to evaluate teachers' competencies essential for promoting physical literacy through fitness monitoring.; Methods: A Delphi study with 30 experts from 26 countries established content validity. Pilot testing on 339 PETs across Europe assessed psychometric characteristics using exploratory factor analysis and Cronbach's Alpha.; Results: The Delphi study identified 13 core competencies, but construct validation revealed 7 dimensions: 1) Supporting cognitive learning, 2) Encouraging positive feedback and learning climate, 3) Understanding of fitness concept, 4) Emotional support, 5) Planning, 6) Understanding of physical literacy concept, 7) Explaining learning objectives. Thus, the final instrument, FitBack PET competency questionnaire, was designed with 27 items covering 7 competencies. The instrument exhibited high reliability, with Cronbach's alpha exceeding 0.7 for 6 factors and the intraclass correlation coefficient of 0.94 for test-retest.; Conclusions: The instrument's development was successful, demonstrating high validity and reliability. The final version is publicly available, providing a practical tool for teacher training programs.

Keywords: pedagogy; fitness monitoring; physical literacy; physical education teacher; competency; assessment

1. Introduction

Adequate physical activity (PA) among school-aged children and adolescents enhances physical fitness, academic performance, and cognitive skills (Chacón-Cuberos et al., 2020; Janssen & LeBlanc, 2010; Poitras et al., 2016). However, fewer than 40% of children achieve the recommended levels of PA levels (Aubert et al., 2018). This alarming situation has led to increased interest in physical literacy (PL) as a framework for promoting lifelong engagement in PA (Li et al., 2020; Sum & Whitehead, 2021).

According to the International Physical Literacy Association (International Physical Literacy Association, 2017) the definition of PL can be described as "motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life". While definitions may vary, most frameworks emphasize the holistic nature of PL, highlighting the importance of affective, physical, and cognitive traits required for lifelong participation in PA (Liu & Chen, 2020; Quennerstedt et al., 2021; Young et al., 2020).

Enhancing PL is a key objective of physical education (PE), which equips students with the skills, confidence, and knowledge to engage in lifelong PA. Beyond promoting physical health, PE supports students' mental and social well-being, fostering positive attitudes toward movement and healthy living (Durden-Myers et al., 2018; Whitehead, 2010). In this context, PE teachers (PETs) play a critical role in promoting PL, ensuring that students acquire the motivation, confidence, and skills to

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maintain meaningful PAs throughout their lives (Whitehead, 2010, 2013). To promote PL effectively, PETs must be equipped with a range of competencies that enable them to teach the knowledge, attitudes, and behaviors necessary for fostering lifelong PA (Yi et al., 2020).

1.1. Physical Literacy and Physical Fitness Monitoring

One of essential parts of PL is Physical Competence, which refers to an individual's ability to develop movement skills and patterns, and the capacity to experience a variety of movement intensities and durations (Rudd et al., 2020). Enhanced Physical Competence supports diverse PAs and relies on interconnected fitness and motor skills. Put simply, enhancing motor skills boosts fitness and vice versa. A physically literate person moves confidently and interacts effectively in various situations, supported by fitness, motor skills, and knowledge of activities and sports. This fosters positive attitudes and lifelong motivation for PA, relying on a fitness level and skills enabling effective and aesthetic movement.

Consequently, well-implemented fitness monitoring can be a valuable tool for promoting PL. Being physically fit reflects the capacity to manage daily tasks energetically and handle emergencies (Caspersen et al., 1985). Tracking changes in fitness levels of the same individuals over time is known as physical fitness monitoring (Brazo-Sayavera et al., 2024). Therefore, fitness monitoring allows teachers to assess students' physical capabilities, track their progress, and tailor instruction to meet individual needs. Research indicates that physical fitness during childhood and adolescence is a critical indicator of overall health and a predictor of future well-being, with links to reduced mortality and prevention of conditions related to physical inactivity (Kodama et al., 2009a, 2009b; Ortega et al., 2008; Twisk et al., 2002). There is also correlation with better mental health (Cadenas-Sanchez et al., 2021), higher cognitive abilities (Cadenas-Sanchez et al., 2020) and educational achievements (Syväoja et al., 2019).

Proper fitness monitoring encourages lifelong activity (Wiersma & Sherman, 2008). Studies have shown a link between objectively measured fitness and self-perceived fitness, suggesting that higher levels of self-perceived fitness may enhance PL (Pastor-Cisneros et al., 2021). Furthermore, health-related fitness knowledge has been closely linked to increased PA (Demetriou et al., 2015; Ferkel et al., 2014; Keating et al., 2009), highlighting its importance in PE curricula. Conversely, inappropriate fitness testing can deter students from fitness monitoring and exercising, sparking debate about the value of fitness testing in PE setting (Cale et al., 2007; Liu, 2008; Lloyd et al., 2010; Rowland, 1995).

Despite the importance of physical fitness and its monitoring in schools (Joensuu et al., 2024; Lang et al., 2023), there is a gap in research focusing on the specific competencies PETs need to effectively use fitness monitoring to enhance PL, like providing safe and inclusive fitness testing environment, fitness assessment knowledge, data interpretation, and the skills to guide students in analyzing fitness data to identify patterns and trends, fostering critical thinking about their physical fitness progress.

1.2. Physical Education Teacher Competencies

Research on PETs' effectiveness increasingly adopts competency-based approaches (Backman & Pearson, 2015). Competence in this context refers to the skills, knowledge, and abilities that teachers need to meet professional challenges and perform effectively in their roles (Shavelson & Partners, 2013). While extensive research exists on general PETs competencies (Aldrup et al., 2020; Baños et al., 2022; Cañadas et al., 2020; Suroto et al., 2017; Tul et al., 2019), there is limited focus on those required for promoting PL through fitness monitoring. Given PL's complexity and the growing significance of fitness monitoring (Lang et al., 2023), developing an instrument to assess PETs' competencies is critical.

Teacher competence in PE has a significant impact on student outcomes. Effective PETs combine technical skills, knowledge, attitude and character to deliver high quality teaching (Francesco et al., 2019). Teacher support and a mastery-oriented climate characterized by positive teacher-student interactions (Yan et al., 2022) motivate students. Research on motivational climate also suggests that

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a task-oriented climate increases the enjoyment of learning and reduces anxiety, while an ego-oriented climate tends to increase anxiety (Huhtiniemi et al., 2022). Effective lesson planning is another important skill, as gaps in PETs' plans affect the quality of teaching and engagement (Güneş et al., 2022). Planning and self-awareness are also key to successful fitness testing in PE (Keating & Silverman, 2009).

This study aims to develop and validate an instrument to assess PETs' competencies in promoting PL through fitness monitoring. Addressing this research gap will provide a tool to evaluate teacher education programs and improve PL promotion in schools. It will also support pilot interventions to improve PETs' competencies using the FitBack toolkit.

2. Materials and Methods

To develop an instrument to assess PETs' competencies in using fitness monitoring to promote PL, a two-step process was employed: 1) a Delphi study, 2) psychometric evaluation. The Delphi process, a well-established method for reaching expert consensus, was used to gather expert opinions on key competencies. This iterative process involves multiple rounds of surveys, allowing for the incorporation of diverse perspectives and the refinement of ideas through expert feedback (Hsu & Sandford, 2007; Okoli & Pawlowski, 2004). Following the Delphi study, a pilot study was conducted to evaluate the psychometric properties of the developed instrument. Based on the findings of pilot study, the final instrument was defined.

2.1. Participant selection in Delphi study

A total of 35 experts from 26 countries were invited to participate, including participants from 9 non-European countries to ensure global perspectives. Experts were identified based on their academic and practical experience in PE, professional involvement in teacher education programs, and publications related to PL or fitness monitoring. Invitations were sent via email, and of the 35 invited experts, 30 agreed to participate, while 5 were unable to take part due to prior commitments.

2.2. Data collection in Delphi study

The Delphi study involved three rounds of iterative surveys. The initial competency framework was based on the Compe-PET model (Baumgartner, 2022), which outlines key areas of competency for PETs: (1) improving professional knowledge, (2) enhancing perception and decision-making skills (P-I-D), and (3) applying quality teaching criteria. We also integrated the QualiTePE framework (Langer & Gerlach, 2024), which focuses on general pedagogical performance, including subject-specific instruction and classroom management.

First round: Participants were asked to assess the Compe-PET model and provide feedback on a preliminary set of competencies by an online survey platform 1KA (1KA, 2023). These competencies were derived from existing literature on teacher effectiveness and PL, and focused on how fitness monitoring could be used as an educational tool to enhance PL in students. Participants were also invited to suggest additional competencies they felt were essential for promoting PL in adolescents.

Second round: Based on the feedback from round 1, the competencies were refined. The updated set of competencies was returned to the experts for further evaluation and prioritization. Experts rated the importance of each competency on a Likert scale and provided qualitative feedback to further refine the list.

Third round: A final round was conducted to achieve ≥ 75% consensus on the competency framework. Experts were asked to confirm their agreement or suggest final modifications. At the end of this round, a consensus was reached on a final set of core competencies for PETs in promoting PL through fitness monitoring.

Based on the findings of the Delphi study, the FitBack PET Competency Questionnaire (FitBack PETC-Q) was prepared. The participants assessed all sentences describing a specific competence using a 5-point Likert-type scale. These options were: "This totally applies to me", "Mostly applies

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to me", "Applies to me to some extent", "Mostly does not apply to me", "This does not apply to me at all."

2.3. Sampling and data collection for psychometric evaluation

A total of 339 PETs from ten European countries (Spain, Estonia, Croatia, Finland, Italy, Slovenia, Portugal, Serbia, Türkiye, Hungary) were recruited via convenience sampling. Recruitment was facilitated through the FitBack network. Invitations were sent via email, containing a link to an online survey platform. Proficiency in English was the primary inclusion criterion, as the questionnaire was administered in English. Participation was voluntary and anonymous, with informed consent obtained from participants before they accessed the questionnaire. To check the test-retest reliability of the instrument, a subset of participants (N:20) completed the questionnaire twice, with a two-week interval between administrations.

Data collection was carried out using an online survey platform 1KA (1KA, 2023), which allowed for efficient distribution and response tracking.

2.4. Data analysis

Content validity was established during the Delphi study, where experts from various fields provided feedback on the relevance and clarity of each competence. To assess construct validity, an exploratory factor analysis (EFA) was conducted using the data collected in the pilot study. EFA was used to identify the underlying factor structure of the instrument, determining whether the competencies grouped together in meaningful ways by applying principal axis factoring with varimax rotation.

The reliability of the instrument was assessed through internal consistency and test-retest reliability measures. Cronbach's alpha was calculated for each of the identified factors, and the test-retest reliability of the questionnaire was evaluated using the Intraclass Correlation Coefficient (ICC) with a two-way mixed-effects model based on both consistency and absolute agreement with average measures

2.5. Ethical Considerations

The study adhered to ethical guidelines for research involving human subjects. All participants were informed about the purpose of the study, and written consent was obtained from all participants. Participation was voluntary, and responses were collected anonymously to protect participants' privacy. Ethical approval for the study was granted by the Ethics Committee at the Faculty of Sport, University of Ljubljana (Number: 033-6/2024-30).

3. Results

3.1. Delphi Study Findings

First Round: In the first round of the Delphi study, experts showed strong consensus on the teaching approach and conceptual foundation of the Come-PET model and QualiTePE framework. They endorsed a list of 22 competencies derived from both literature and expert recommendations as essential for PETs to promote PL (Tables S 1 and S 2). While these competencies aligned well with theoretical foundations, experts suggested adding social climate and empathy for a more comprehensive approach. This feedback confirmed a robust foundation for further refinement and exploration in subsequent rounds.

Second Round: In the second round of the Delphi study, the focus was on narrowing the competencies and revising language for greater clarity and practical application, resulting in a refined list of 13 competencies with five assessment items each (Tables S 3 and S 4). These competencies emphasized fitness monitoring as a tool to promote PL among students, while experts highlighted the importance of a holistic approach that addresses the cognitive, affective, and social dimensions

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of PL. There was strong consensus on prioritizing enjoyment, personal growth, and inclusive, supportive environments over standardized fitness assessments, ensuring the tool was both theoretically sound and practical for PETs.

Third Round: In the final round, expert feedback led to further streamlining of the assessment tool, resulting in 13 competencies, each with 3 specific items (Table 1). This iterative refinement ensured that the instrument was practical and aligned with the real-world context of PE, focusing on teachers' ability to promote PL through fitness monitoring. With 13 experts providing final validation, the instrument was completed and prepared for psychometric evaluation.

Table 1. Final version of the competencies and questions selected from Delphi study.

Competencies	Items
Understanding of fitness concept	• I have a good understanding of health benefits associated with several fitness components (e.g. body composition, cardiorespiratory fitness, strength, power, flexibility). • I understand which tests assess specific fitness components. • I understand the difference between fitness testing and fitness monitoring.
Understanding of fitness report	• I know how to interpret centiles in fitness reports. • I understand the meaning of health risk zones within fitness reports. • I am skilled in establishing individualized target goals for students based on fitness reports.
Understanding of physical literacy concept	• I understand that physical literacy and physical competence are different concepts. • I believe all students, regardless of their abilities, have the potential to enhance their physical literacy. • I think being on board the journey of physical literacy promotes and maintains the responsibility for engaging in physical activity for life.
Clear learning objectives associated with fitness testing	• Before conducting physical fitness testing, I provide students with an explanation of what will be tested and why these assessments are relevant and beneficial for them. • I discuss with students about the purpose of physical fitness testing before assessment. • I clarify the goals and benefits of fitness testing with my students, emphasizing its role for overall physical development.
Planning of PE classes based on fitness monitoring	• I customize the content and intensity based on my students` fitness levels as indicated by their fitness test results. • I incorporate class fitness goals along with other group characteristics (e.g. skills, social interaction) to develop targeted learning objectives for each student. • I consistently reassess and modify the structure of my PE classes based on ongoing fitness monitoring.
Selection of challenging content in fitness exercising	• I create fitness routines that integrate skill development and targeted challenges to enhance physical fitness and sport-specific skills. • I give students chances to test their understanding on how fitness affects some movement through specific challenges. • I integrate knowledge of fitness components into skill-related PE classes.
Promotion of a positive learning climate during fitness testing and exercising	• I react immediately to any type of bullying or other inappropriate behavior during fitness testing and exercising. • I encourage students to only compare their score to their previous scores, but not to compete during fitness testing. • I reinforce positive attitudes during fitness testing, emphasizing mutual respect and fair play among students
Student-centered teaching climate	• I acknowledge students` suggestions regarding the content of PE classes aiming to improve fitness levels.

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during PE classes aiming to improve fitness levels	• I empower students to make decisions in PE classes for fitness improvement whilst promoting ownership. • I adapt teaching strategies to meet students` needs, ensuring meaningful and relevant exercises in PE classes.
Encouraging feedback during fitness exercising	• I praise students when they improve themselves, irrespective of their fitness levels. • I provide feedback that encourages my students to perform exercises better. • I provide constructive feedback that celebrates students` progress, emphasizing effort and improvement regardless of initial fitness levels.
Promotion of students' cognitive activity through fitness testing and exercising	• I assist students in developing their own individual exercise plans to improve their fitness levels. • I encourage students to reflect on how they performed the exercises. • I guide students in analyzing fitness data to foster critical thinking about their physical fitness progress.
Supporting metacognitive learning through fitness testing and exercising	• I encourage students to articulate the reasons behind their choice of specific exercises for developing fitness. • I support students in analyzing and revising their fitness goals and strategies based on self-assessment and feedback. • I ask students how they achieved their goals in fitness exercising.
Emotional support in fitness exercising	• I care about all students 'problems during fitness exercising. • I adapt teaching and the learning environment if my students express difficulties with fitness exercises. • I offer empathy and encouragement to students facing challenges during fitness exercises by creating a supportive environment for all participants.
Supporting differentiation in fitness exercising	• I offer different exercises to students depending on their fitness levels. • I let students with a higher fitness level try more difficult exercises. • I often organize fitness exercising in groups of students with similar fitness level.

3.2. Psychometric Evaluation

EFA yielded a factor solution that explained 54% of the variance in the data, with seven distinct factors emerging from the analysis. These factors were based on a minimum factor loading of 0.30, and all communalities exceeded 0.30 (Table S 5). Key tests were used to assess the suitability of the data for factor analysis: Bartlett's Test of Sphericity was significant (χ^2 (n=351) = 4137, $p < 0.001$), confirming the adequacy of the correlation matrix (Bartlett, 1954; Fabrigar & Wegener, 2011; Guttman, 1954). The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.904, indicating that the data was excellent for factor analysis (Guttman, 1954; Kaiser, 1974; Kaiser & Rice, 1974).

The EFA identified seven key factors that differed somewhat from the original theoretical framework established during the Delphi process. Consequently, certain factors and items from the questionnaire defined through a Delphi study were excluded from the final instrument. Additionally, some items from the initial factors were combined to form new constructs. This refinement process streamlined the tool, making it more focused and better suited for practical application in educational settings (Table 2). The study emphasized seven essential competencies for effective fitness testing and exercise. These included promoting cognitive and metacognitive learning, fostering positive feedback and a supportive learning climate, understanding fitness concepts and interpreting related reports, providing emotional support and adapting to individual needs, planning effective fitness monitoring sessions, promoting physical literacy, and clearly articulating educational objective.

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Table 2. Final version of FitBack PETC-Q from EFA.

Competencies from Delphi Study	Competencies from EFA	Items	Factor Loading
Selection of challenging content in fitness exercising Student-centered teaching climate during PE classes aiming to improve fitness levels	**Supporting cognitive learning**	• I encourage students to articulate the reasons behind their choice of specific exercises for developing fitness.	77
		• I support students in analyzing and revising their fitness goals and strategies based on self-assessment and feedback.	.77
		• I ask students how they achieved their goals in fitness exercising.	.68
		• I guide students in analyzing fitness data to foster critical thinking about their physical fitness progress.	.72
		• I assist students in developing their own individual exercise plans to improve their fitness levels.	.62
Promotion of students' cognitive activity through fitness testing and exercising Clear learning objectives associated with fitness testing	**Encouraging positive feedback and learning climate**	• I provide feedback that encourages my students to perform exercises better.	.64
		• I reinforce positive attitudes during fitness testing, emphasizing mutual respect and fair play among students.	.68
		• I provide constructive feedback that celebrates students` progress, emphasizing effort and improvement regardless of initial fitness levels.	.46
		• I praise students when they improve themselves, irrespective of their fitness levels.	.51
		• I react immediately to any type of bullying or other inappropriate behavior during fitness testing and exercising.	.56
Planning of PE classes based on fitness monitoring Understanding of fitness concept	**Understanding of fitness concept**	• I know how to interpret centiles in fitness reports.	.67
		• I understand which tests assess specific fitness components.	.64
		• I understand the meaning of health risk zones within fitness reports.	.62
		• I understand the difference between fitness testing and fitness monitoring.	.66
Promotion of a positive learning climate during fitness testing and exercising Understanding of fitness report	**Emotional support**	• I adapt teaching and the learning environment if my students express difficulties with fitness exercises.	.60
		• I offer different exercises to students depending on their fitness levels.	.56
		• I offer empathy and encouragement to students facing challenges during fitness exercises by creating a supportive environment for all participants.	.58
		• I care about all students' problems during fitness exercising.	.55
Encouraging feedback during fitness exercising	**Planning**	• I incorporate class fitness goals along with other group characteristics (e.g. skills, social interaction) to develop targeted learning objectives for each student.	.62
		• I consistently reassess and modify the structure of my PE classes based on ongoing fitness monitoring.	.65

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Understanding of Physical literacy concept		• I customize the content and intensity based on my students` fitness levels as indicated by their fitness test results.	.47
Supporting meta-cognitive learning through fitness testing and exercising	**Understanding of physical literacy concept**	• I believe all students, regardless of their abilities, have the potential to enhance their physical literacy.	.76
		• I think being on board the journey of physical literacy promotes and maintains the responsibility for engaging in physical activity for life	.40
		• I understand that physical literacy and physical competence are different concepts.	.30
Emotional support in fitness exercising	**Explaining Learning objectives**	• I discuss with students about the purpose of physical fitness testing before assessment.	.64
		• I clarify the goals and benefits of fitness testing with my students, emphasizing its role for overall physical development.	.61
Supporting differ-initiation in fitness exercising		• Before conducting physical fitness testing, I provide students with an explanation of what will be tested and why these assessments are relevant and beneficial for them	.61

3.3. Reliability

3.1.1. Internal Consistency

We used the standard approach to assess internal consistency; a construct is usually considered reliable if the Cronbach's Alpha (α) value is greater than 0.7 (Peterson, 1994). The results revealed that all constructs except Understanding of physical literacy concept (α=.65) were well above this threshold. Despite this, the overall reliability results confirm that the FitBack PETC-Q is a reliable tool for assessing competencies related to PETs' promotion of PL through fitness monitoring (Table 3).

Table 3. Cronbach's Alpha for different constructs of FitBack PETC-Q.

Constructs	No. of Items	Cronbach's α
Supporting cognitive learning	5	.86
Encouraging positive feedback and learning climate	5	.80
Understanding of fitness concept	4	.79
Emotional support	4	.76
Planning	3	.79
Understanding of physical literacy concept	3	.65
Explaining learning objectives	3	.82

3.1.2. Test-retest reliability

The test-retest reliability of the questionnaire was evaluated using the ICC with a two-way mixed-effects model based on both consistency and absolute agreement with average measures. The ICC for average measures based on absolute agreement was 0.92 (95% CI: 0.85–0.96, $p < 0.001$), while the ICC based on consistency was 0.94 (95% CI: 0.89–0.97, $p < 0.001$). These results demonstrate a high degree of consistency between test and retest scores, confirming the stability of the questionnaire over time., indicating excellent reliability (Koo & Li, 2016).

4. Discussion

The objective of this study was to develop an instrument to assess PETs' competencies in utilizing physical fitness monitoring to enhance PL. A Delphi study was initially conducted to establish content validity through expert consensus. This process resulted in a set of 13 competencies,

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each assessed by 3 items. Subsequently, a psychometric evaluation of the instrument was performed. Based on the findings, the final instrument, the FitBack PETC-Q, was designed, with a total of 27 items covering 7 dimensions. Results indicated that FitBack PETC-Q demonstrated strong construct validity and reliability in assessing PETs' competencies in employing fitness monitoring to promote PL.

The results of the Delphi study provide important insights into the development and refinement of competencies for PETs. A comprehensive review of the literature, along with expert input, led to the identification of 22 initial competencies, creating a strong basis for further refinement. The clear alignment between expert perspectives and theoretical frameworks of Compe-PET and QualiTePE emphasized the critical role these competencies play in fostering PL and effective teaching. Expert feedback facilitated the refinement process, reducing the competencies to a more focused set of 13, each with 3 specific evaluation items. These revisions enhanced the clarity of the competencies and placed greater emphasis on fitness monitoring as an important strategy for promoting PL. Additionally, this process improved the language used, making the competencies more practical and applicable in educational contexts.

The construct validity and reliability of the instrument were confirmed through several statistical analyses. The seven dimensions emerged from the EFA—*Supporting cognitive learning, Encouraging positive feedback and learning climate, Understanding of fitness concept, Emotional support, Planning, Understanding of physical literacy concept, Explaining learning objectives*—closely aligned with the competencies identified during the Delphi study; although some were consolidated or redefined for practical application. For example, the *Supporting cognitive learning* dimension, with five items, merged elements related to cognitive and metacognitive learning through fitness testing, while *Understanding of fitness concept* emphasized the importance of understanding of fitness concept and fitness reports. The strong construct validity of the instrument is demonstrated by an EFA that explained a significant portion of the variance, alongside a KMO measure indicating excellent sampling adequacy and significant Bartlett's Test results. The analysis revealed independent factors with high loadings and communalities, confirming that the items effectively measure their intended constructs.

In evaluating the instrument's reliability, we found that most constructs demonstrated robust internal consistency, as evidenced by their Cronbach's Alpha values. All constructs besides *Understanding of physical literacy* concept not only met but also surpassed the standard threshold for reliability, indicating their effectiveness in assessing the targeted competencies. We decided to retain this factor even if α <.70 because it has a clear structure and perfectly matches the results from Delphi (all three items were the same). In contrast, the PL construct showed a comparatively lower alpha value, suggesting that this area could benefit from further refinement to improve its reliability. Nonetheless, the overall findings affirm that FitBack PETC-Q is a reliable tool for evaluating core competencies of PETs, particularly in supporting PL through effective fitness monitoring practices. This highlights the instrument's suitability for use in educational contexts focused on enhancing the quality of PE. Furthermore, the questionnaire demonstrated excellent test-retest reliability, confirming its strong consistency and stability over time.

The findings of this study align with and expand upon existing literature regarding the competencies of PETs, particularly in the promotion of PL. The identification of seven key competencies in this study mirrors argument that effective PE teaching requires a multifaceted approach that goes beyond basic teaching skills and includes also personal traits and teaching effectiveness (Francesco et al., 2019). Similarly, the emphasis of emotional support and differentiation within the *Emotional support* competence underscores that effective instruction on fitness topics within PE extends beyond physical guidance. PETs must adopt their teaching approaches to accommodate students with varying fitness levels. This might involve offering alternative exercises or providing additional support and encouragement to students facing challenges. By fostering a supportive environment for all participants, PETs can help students overcome obstacles and develop a positive attitude towards fitness testing and exercising.

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A crucial element of an effective PE class is the influence of teacher support and a motivating atmosphere on student outcomes, particularly in boosting enjoyment and reducing anxiety in PE environments (Huhtiniemi et al., 2022; Yan et al., 2022). This finding is consistent with the emphasis placed on the *Encouraging positive feedback and learning climate* in our instrument, which encourages positive reinforcement and a supportive learning climate during fitness monitoring. When PETs acknowledge students' efforts to enhance their exercise skills, recognize achievements with feedback focused on growth and effort rather than initial abilities, and applaud students for personal progress regardless of their fitness levels, they help build a positive learning atmosphere. This supportive environment is crucial for developing PL and encouraging students to participate actively in fitness activities.

Additionally, it's crucial to consider teaching goals, time constraints, and teacher confidence when implementing fitness assessments (Keating & Silverman, 2009). Our study builds on this concept by creating a specific competency framework for fitness monitoring, including competencies such as *Planning* and *Explaining learning objectives*. Students are required to understand the purpose of fitness testing before it begins, including what will be assessed and why these tests are meaningful and beneficial for their overall physical development. PETs need to make sure students are well-informed about these aspects.

Many PETs are often insufficiently detailed in their lesson plans, particularly in relation to aspects such as teaching methods, assessment techniques and reflection activities (Güneş et al., 2022). Strong planning skills are crucial for delivering high-quality PE instruction. Our findings add to this discussion by providing a comprehensive framework to assess and enhance PETs' planning abilities to introduce fitness monitoring. Teachers are expected to continuously evaluate and adjust their class structure in response to ongoing fitness assessments, tailoring content and intensity to align with students' fitness levels as indicated by their test results.

However, to fully understand students' fitness scores, PET should possess a well-developed competence *Understanding of fitness concept*, as identified in our study (Castelli & Williams, 2007; Santiago & Morrow, 2021). A fitness-competent PETs can understand percentiles in fitness reports to assess students' relative fitness levels. They are able to identify which tests measure specific components of fitness, allowing for a targeted approach to fitness education. Additionally, they can recognize health risk zones within fitness reports, helping them identify students who may need additional support. Finally, they understand that continuous assessment is essential for tracking true progress. This enables them to guide students facing health risks to understand their condition and motivate others to recognize their health status and take steps to improve or maintain their fitness levels.

Finally, it was found that cognitive and emotional elements play a crucial role in developing PL through physical fitness exercising in PE (Eastham, 2018; Gilic et al., 2022). When PETs engage students in understanding the rationale behind specific fitness exercises, guide them in evaluating and adjusting their fitness goals based on self-assessment and feedback, and encourage them to analyze fitness data to think critically about their progress, students are empowered to create personalized exercise plans to enhance their fitness. This approach actively supports students' cognitive growth within their PL journey. Ultimately, this process serves as a practical tool to assess how effectively teachers promote these cognitive and emotional aspects through fitness monitoring, offering a tangible way to apply theoretical concepts in practice. This process mirrors competence *Supporting cognitive learning* from our study.

Overall, the findings of our study complement existing literature by offering a structured, psychometrically evaluated instrument that captures essential PETs competencies to support PL journey with well-implemented fitness monitoring and exercising. In doing so, it bridges the gap between theoretical insights and practical application, providing a valuable resource for enhancing teacher training and professional development in PE.

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4.1. Implications for theory and practice

This study significantly contributes to the theoretical frameworks of PETs competencies, PL, and fitness testing. By refining competencies that enable PETs to promote PL through fitness monitoring, the study enhances models like Come-PET and QualiTePE. It shifts the view of fitness testing from merely assessing physical fitness to fostering cognitive and metacognitive growth in students, extending educational theories around PL. Practically, the 7 identified competencies provide a framework that can improve PE teaching methods. Integrating these competencies into teacher training programs equips educators to address the cognitive, social, and emotional aspects of fitness topics in PE teaching. This approach allows teachers to better track student progress, create supportive learning environments, and adapt to diverse student needs. Furthermore, the validated instrument offers a practical and reliable tool for assessing these competencies, making it a valuable resource for teacher educators and researchers. Specifically, translated versions of this instrument will be used to evaluate the effects of FitBack toolkit intervention, where group of European PETs will use FitBack toolkit translated in their mother language in their PE teaching. In the near future, FitBack PET-Q could become also part of self-assessment tool in this toolkit. Furthermore, instruments provide good opportunities for European wide study on the level of PETs competencies in using fitness monitoring to promote PL.

The study also has policy implications. PETs as well as generalist teachers' education curricula should incorporate these competencies into teacher preparation and certification programs, emphasizing proper fitness monitoring as an important tool for promoting PL. Continuous professional development programs should further train in-service teachers on this approach, and educational policies should revise curricula to align with PL goals, supported by regular fitness assessments and suitable feedback. Implementing these changes can lead to improved teaching practices, better student outcomes, and a broader understanding of fitness monitoring in education. Furthermore, this instrument holds potential for application in epidemiological research, enabling the identification of regions or countries where a significant proportion of teachers of PE demonstrate low competency levels, thereby informing targeted interventions such as enhanced teacher training programs.

4.2. Strengths and limitations of the study

The strengths of this study include its European dimension and the two-stage validation process. The instrument was developed with the participation of international experts through a Delphi study, followed by a pilot study conducted in 10 European countries with different cultures and educational systems. These features increase the potential for international applicability of the results. However, the international focus of the study also entails limitations. English language proficiency was a primary inclusion criterion for the pilot study, which may have resulted in a sample of PETs with generally higher competencies. However, the questionnaire was completed in a web browser, so teachers were able to use a translation tool. Nevertheless, this may have influenced the distribution of scores, resulting in a lower percentage of lower scores. However, this has no influence on the results of the factor analysis.

Future research opportunities could utilize longitudinal designs to examine how the identified competencies correlate with improved teaching practices and student PL outcomes over time. Additionally, qualitative research methods, such as interviews or focus groups with educators, could offer valuable insights into the practical challenges and benefits of implementing the identified competencies in real-world educational settings.

5. Conclusions

This study identified and refined a set of 7 competencies for teachers to promote PL through fitness monitoring. These competencies can be used both in teacher training and in curriculum development. The instrument's development was successful, demonstrating high validity and

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reliability. The final version is publicly available on https://1ka.arnes.si/a/ce113f23&preview=on&testdata=on.

Abbreviations

The following abbreviations are used in this manuscript:

PETC-Q	Physical Education Teacher Competency Questionnaire
PETs	Physical Education Teachers
PET	Physical education teacher
EFA	exploratory factor analysis
KMO	Kaiser-Meyer-Olkin
ICC	Intraclass Correlation Coefficient
PA	physical activity
PL	physical literacy
PE	physical education

Appendix A

Fitness Monitoring and Physical Literacy Expert Group Participants:

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References

1. (1KA, 2023) Faculty of Social Sciences, University of Ljubljana. (2023). 1KA (Version 23.06.20) [Software]. https://www.1ka.si
2. Aldrup, K., Carstensen, B., Köller, M. M., & Klusmann, U. (2020). Measuring teachers' social-emotional competence: Development and validation of a situational judgment test. *Frontiers in Psychology*, *11*, Article 892. https://doi.org/10.3389/fpsyg.2020.00892
3. Aubert, S., Barnes, J. D., Abdeta, C., Nader, P. A., Adeniyi, A. F., Aguilar-Farias, N., ... Tremblay, M. S. (2018). Global Matrix 3.0 physical activity report card grades for children and youth: Results and analysis from 49 countries. *Journal of Physical Activity and Health, 15*(S2), S251–S273. https://doi.org/10.1123/jpah.2018-0472

 doi:10.20944/preprints202503.0414.v1

4. Backman, E., & Pearson, P. (2015). "We should assess the students in more authentic situations." *Physical Education and Sport Pedagogy, 22*(1), 47–64. https://doi.org/10.1177/1356336x15589203
5. Baños, R., Parra, J. P. M., Ruvalcaba, M. B., Morán, J. C. P., & Extremera, A. B. (2022). Psychometric properties and measurement invariance by gender of the Teacher Competency Evaluation Scale for Physical Education in the Mexican context. Retos: Nuevas Tendencias en Educación Física, *Deporte y Recreación, 46*, 349–357.
6. Bartlett, M. S. (1954). A note on the multiplying factors for various χ^2 approximations. *Journal of the Royal Statistical Society: Series B (Methodological), 16*(2), 296–298. https://doi.org/10.1111/j.2517-6161.1954.tb00174.x
7. Baumgartner, M. (2022). Professional competence(s) of physical education teachers: Terms, traditions, modelling and perspectives. *German Journal of Exercise and Sport Research, 52*(4), 550–557. https://doi.org/10.1007/s12662-022-00840-z
8. (Brazo-Sayavera et al., 2024) Brazo-Sayavera, J., Silva, D. R., Lang, J. J., Tomkinson, G. R., Agostinis-Sobrinho, C., Andersen, L. B., ... Dos Santos, L. (2024). Physical fitness surveillance and monitoring systems inventory for children and adolescents: A scoping review with a global perspective. *Sports Medicine, 54*(7), 1755–1769. https://doi.org/10.1007/s40279-024-02038-9
9. Cadenas-Sánchez, C., Mena-Molina, A., Torres-López, L. V., Migueles, J. H., Rodriguez-Ayllon, M., Lubans, D. R., & Ortega, F. B. (2021). Healthier minds in fitter bodies: A systematic review and meta-analysis of the association between physical fitness and mental health in youth. *Sports Medicine, 51*(12), 2571–2605. https://doi.org/10.1007/s40279-021-01520-y,
10. Cadenas-Sánchez, C., Migueles, J. H., Erickson, K. I., Esteban-Cornejo, I., Catena, A., & Ortega, F. B. (2020). Do fitter kids have bigger brains? *Scandinavian Journal of Medicine & Science in Sports, 30*(12), 2498–2502. https://doi.org/10.1111/sms.13824
11. Cale, L., Harris, J., & Chen, M. H. (2007). More than 10 years after "The horse is dead …": Surely it must be time to "dismount"?! *Pediatric Exercise Science, 19*(2), 115–131. https://doi.org/10.1123/pes.19.2.115
12. Añadas, L., Santos-Pastor, M. L., & Castejón, F. J. (2020). Physical education teachers' competencies and assessment in professional practice. Apunts. *Educación Física y Deportes, 139*, 33–41. https://doi.org/10.5672/apunts.2014-0983.es.(2020/1).139.05
13. Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports, 100*(2), 126.
14. Castelli, D., & Williams, L. (2007). Health-related fitness and physical education teachers' content knowledge. *Journal of Teaching in Physical Education, 26*(1), 3–19.
15. Chacón-Cuberos, R., Zurita-Ortega, F., Ramírez-Granizo, I., & Castro-Sánchez, M. (2020). Physical activity and academic performance in children and preadolescents: A systematic review. Apunts. *Educación Física y Deportes, 139*, 1–9. https://doi.org/10.5672/apunts.2014-0983.es.(2020/1).139.01
16. Demetriou, Y., Sudeck, G., Thiel, A., & Höner, O. (2015). The effects of school-based physical activity interventions on students' health-related fitness knowledge: A systematic review. *Educational Research Review, 16*, 19–40. https://doi.org/10.1016/j.edurev.2015.07.002
17. Durden-Myers, E. J., Whitehead, M. E., & Pot, N. (2018). Physical literacy and human flourishing. *Journal of Teaching in Physical Education, 37*(3), 308–311. https://doi.org/10.1123/jtpe.2018-0132
18. Eastham, S. L. (2018). Physical fitness test administration practices and students' cognitive understanding of physical fitness. *The Physical Educator, 75*(3), 374–393. https://doi.org/10.18666/tpe-2018-v75-i3-7933
19. (Fabrigar & Wegener, 2012) Fabrigar, L. R., & Wegener, D. T. (2012). Exploratory factor analysis. Oxford University Press.
20. Ferkel, R. C., Judge, L. W., Stodden, D. F., & Griffin, K. (2014). Importance of health-related fitness knowledge to increasing physical activity and physical fitness. *Physical Educator, 71*(2), 218.
21. (Francesco et al., 2019) Francesco, C., Coco, D., Frattini, G., Vago, P., & Andrea, C. (2019). Effective teaching competences in physical education. *Journal of Physical Education and Sport, 19*, 1806–1813. https://doi.org/10.7752/jpes.2019.s5265
22. Gilic, B., Malovic, P., Sunda, M., Maras, N., & Zenic, N. (2022). Adolescents with higher cognitive and affective domains of physical literacy possess better physical fitness: The importance of developing the

 doi:10.20944/preprints202503.0414.v1

concept of physical literacy in high schools. *Children, 9*(6), Article 796. https://doi.org/10.3390/children9060796

23. Güneş, B., Mirzeoglu, A. D., Karadag, O., Atli, K., & Yalcinkaya, N. (2022). Evaluation of daily lesson planning competency of physical education and sports teachers. *Journal of Qualitative Research in Education, 22*(32). https://doi.org/10.14689/enad.32.1550
24. Guttman, L. (1954). Some necessary conditions for common-factor analysis. *Psychometrika, 19*(2), 149–161. https://doi.org/10.1007/bf02289162
25. Hsu, C. C., & Sandford, B. A. (2007). The Delphi technique: Making sense of consensus. *Practical Assessment, Research, and Evaluation*, 12(1).
26. Huhtiniemi, M., Sääkslahti, A., Tolvanen, A., Watt, A., & Jaakkola, T. (2022). The relationships among motivational climate, perceived competence, physical performance, and affects during physical education fitness testing lessons. *European Physical Education Review, 28*(3), 594–612.
27. International Physical Literacy Association. (2024). Physical education definition. Retrieved October 30, 2024, from https://www.physical-literacy.org.uk/
28. Janssen, I., & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity, 7*, Article 16.
29. Joensuu, L., Csányi, T., Huhtiniemi, M., Kälbi, K., Magalhães, J., Milanović, I., Morrison, S. A., Ortega, F. B., Sardinha, L. B., Starc, G., Tammelin, T. H., & Jurak, G. (2024). How to design and establish a national school-based physical fitness monitoring and surveillance system for children and adolescents: A 10-step approach recommended by the FitBack network. *Scandinavian Journal of Medicine & Science in Sports, 34*(3). https://doi.org/10.1111/sms.14593
30. Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*(1), 31–36. https://doi.org/10.1007/bf02291575
31. Kaiser, H. F., & Rice, J. (1974). Little jiffy, mark IV. *Educational and Psychological Measurement, 34*(1), 111–117.
32. Kalaycı Önaç, A., & Birişçi, T. (2019). Transformation of urban landscape value perception over time: A Delphi technique application. *Environmental Monitoring and Assessment, 191*(12). https://doi.org/10.1007/s10661-019-7935-9
33. Keating, X. D., Chen, L., Guan, J., Harrison, L., & Dauenhauer, B. (2009). Urban minority ninth-grade students' health-related fitness knowledge. *Research Quarterly for Exercise and Sport, 80*(4), 747–755. https://doi.org/10.1080/02701367.2009.10599616
34. Keating, X. D., & Silverman, S. (2009). Determinants of teacher implementation of youth fitness tests in school-based physical education programs. *Physical Education & Sport Pedagogy, 14*(2), 209–225. https://doi.org/10.1080/17408980801974945
35. (Kodama et al., 2009a) Kodama, S., Saito, K., Tanaka, S., Maki, M., Yachi, Y., Asumi, M., Sugawara, A., Totsuka, K., Shimano, H., Ohashi, Y., Yamada, N., & Sone, H. (2009a). Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events in healthy men and women: A meta-analysis. *JAMA*, 301(19), 2024–2035. https://doi.org/10.1001/jama.2009.681
36. Kodama, S., Saito, K., Tanaka, S., Maki, M., Yachi, Y., Asumi, M., Sugawara, A., Totsuka, K., Shimano, H., Ohashi, Y., Yamada, N., & Sone, H. (2009b). Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events in healthy men and women: A meta-analysis. *JAMA, 301*(19), 2024–2035. https://doi.org/10.1001/jama.2009.681
37. Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine, 15*(2), 155–163. https://doi.org/10.1016/j.jcm.2016.02.012
38. Lang, J. J., Zhang, K., Agostinis-Sobrinho, C., Andersen, L. B., Basterfield, L., Berglind, D., Blain, D. O., Cadenas-Sanchez, C., Cameron, C., Carson, V., Colley, R. C., Csányi, T., Faigenbaum, A. D., García-Hermoso, A., Gomes, T. N. Q. F., Gribbon, A., Janssen, I., Jurak, G., Kaj, M., … Fraser, B. J. (2023). Top 10 international priorities for physical fitness research and surveillance among children and adolescents: A twin-panel Delphi study. *Sports Medicine (Auckland, N.Z.), 53*(2), 549–564. https://doi.org/10.1007/s40279-022-01752-6

 doi:10.20944/preprints202503.0414.v1

39. Langer, W., Gerlach, E., Scheuer, C., Schnitzler, C., Lefèvre, L., & Bailey, R. (2025). *The QualiTePE framework concept* [Manuscript submitted for publication]. Universität Hamburg, Fakultät für Psychologie und Bewegungswissenschaft.
40. Li, M. H., Sum, R. K. W., Sit, C. H. P., Wong, S. H. S., & Ha, A. S. C. (2020). Associations between perceived and actual physical literacy level in Chinese primary school children. *BMC Public Health, 20*(1), Article 8318. https://doi.org/10.1186/s12889-020-8318-4
41. Liu, Y. (2008). Youth fitness testing: If the "horse" is not dead, what should we do? *Measurement in Physical Education and Exercise Science, 12*(3), 123–125. https://doi.org/10.1080/10913670802219134
42. Liu, Y., & Chen, S. (2020). Physical literacy in children and adolescents: Definitions, assessments, and interventions. *Physical Education and Sport Pedagogy, 27*(1), 96–112. https://doi.org/10.1177/1356336x20925502
43. Lloyd, M., Colley, R. C., & Tremblay, M. S. (2010). Advancing the debate on 'fitness testing' for children: Perhaps we're riding the wrong animal. *Pediatric Exercise Science, 22*(2), 176–182. https://doi.org/10.1123/PES.22.2.176
44. Mahajan, V., Linstone, H. A., & Turoff, M. (1976). The Delphi method: Techniques and applications. *Journal of Marketing Research, 13*(3), 317. https://doi.org/10.2307/3150755
45. Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: An example, design considerations, and applications. *Information & Management, 42*(1), 15–29. https://doi.org/10.1016/j.im.2003.11.002
46. Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjöström, M. (2008). Physical fitness in childhood and adolescence: A powerful marker of health. *International Journal of Obesity (2005), 32*(1), 1–11. https://doi.org/10.1038/sj.ijo.0803774
47. Pastor-Cisneros, R., Carlos-Vivas, J., Muñoz-Bermejo, L., Adsuar-Sala, J. C., Merellano-Navarro, E., & Mendoza-Muñoz, M. (2021). Association between physical literacy and self-perceived fitness level in children and adolescents. *Biology, 10*(12), Article 1358. https://doi.org/10.3390/biology10121358
48. Peterson, R. A. (1994). A meta-analysis of Cronbach's coefficient alpha. *Journal of Consumer Research, 21*(2), 381. https://doi.org/10.1086/209405
49. Poitras, V. J., Gray, C. E., Borghese, M. M., Carson, V., Chaput, J. P., Janssen, I., Katzmarzyk, P. T., Pate, R. R., Connor Gorber, S., Kho, M. E., Sampson, M., & Tremblay, M. S. (2016). Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Applied Physiology, Nutrition and Metabolism, 41*(6), S197–S239. https://doi.org/10.1139/APNM-2015-0663
50. Quennerstedt, M., McCuaig, L., & Mårdh, A. (2021). The fantasmatic logics of physical literacy. *Sport, Education and Society*, 26(8), 846–861.
51. Rudd, J. R., Pesce, C., Strafford, B. W., & Davids, K. (2020). Physical literacy—A journey of individual enrichment: An ecological dynamics rationale for enhancing performance and physical activity in all. *Frontiers in Psychology, 11*, Article 1904.
52. Rowland, T. W. (Ed.). (1995). The horse is dead; let's dismount. *Pediatric Exercise Science, 7*(2), 117–120.
53. Santiago, J. A., & Morrow, J. R. (2021). A study of preservice physical education teachers' content knowledge of health-related fitness. *Journal of Teaching in Physical Education, 40*(1), 118–125. https://doi.org/10.1123/JTPE.2019-0138
54. Shavelson, R. J., & Partners, S. K. (2013). On an approach to testing and modeling competence. *Educational Psychologist, 48*(2), 73–86. https://doi.org/10.1080/00461520.2013.779483
55. Sorić, M., Morrison, S. A., Ortega, F. B., Carraro, A., Csányi, T., Leskošek, B., Mäestu, J., Radisavljević-Janić, S., Sardinha, L. B., Scheuer, C., Starc, G., Tammelin, T. H., & Jurak, G. (2024). Development of the FitBack online platform: Enhancing global child fitness assessment, health-related interpretation, and surveillance. *medRxiv*. https://doi.org/10.1101/2024.08.15.24311927
56. Sum, R. K. W., Ha, A. S. C., Cheng, C. F., Chung, P. K., Yiu, K. T. C., Kuo, C. C., Yu, C. K., & Wang, F. J. (2016). Construction and validation of a perceived physical literacy instrument for physical education teachers. *PLOS ONE, 11*(5), Article e0155610. https://doi.org/10.1371/journal.pone.0155610

 doi:10.20944/preprints202503.0414.v1

57. Suroto, Khory, F. D., Dinata, V. C., & Priambodo, A. (2017). Core competency measurement model for prospective physical education teachers. IOP Conference Series: *Materials Science and Engineering, 180*(1), 012181. https://doi.org/10.1088/1757-899X/180/1/012181
58. Syväoja, H. J., Kankaanpää, A., Joensuu, L., Kallio, J., Hakonen, H., Hillman, C. H., & Tammelin, T. H. (2019). The longitudinal associations of fitness and motor skills with academic achievement. *Medicine and Science in Sports and Exercise, 51*(10), 2050–2057. https://doi.org/10.1249/MSS.0000000000002031
59. Tul, M., Leskošek, B., & Kovač, M. (2019). The professional competencies of physical education teachers from North-Eastern Italy. *Center for Educational Policy Studies Journal, 9*(1), 103–120. https://doi.org/10.26529/CEPSJ.662
60. Twisk, J. W. R., Kemper, H. C. G., & Van Mechelen, W. (2002). Prediction of cardiovascular disease risk factors later in life by physical activity and physical fitness in youth: General comments and conclusions. *International Journal of Sports Medicine, 23*(S1), 44–50.
61. Whitehead, M. (2010). *Physical literacy: Throughout the lifecourse.* Routledge. https://doi.org/10.4324/9780203881903
62. Whitehead, M., & Almond, L. (2013). Creating learning experiences to foster physical literacy. *The Journal of the International Council of Sport Science and Physical Education* (No. 65, CD-ROM). https://www.icsspe.org
63. Wiersma, L. D., & Sherman, C. P. (2008). The responsible use of youth fitness testing to enhance student motivation, enjoyment, and performance. *Measurement in Physical Education and Exercise Science, 12*(3), 167–183. https://doi.org/10.1080/10913670802216148
64. Yan, T., Teo, E. W., Lim, B. H., & Lin, B. (2022). Evaluation of competency and job satisfaction by positive human psychology among physical education teachers at the university level: A systematic review. *Frontiers in Psychology, 13*, 1084961. https://doi.org/10.3389/fpsyg.2022.1084961
65. Yi, K. J., Cameron, E., Patey, M., Loucks-Atkinson, A., Loeffler, T. A., Sullivan, A. M., McGowan, E., Borduas, C., & Buote, R. (2020). Future directions for physical literacy education: Community perspectives. *Journal of Physical Education and Sport, 20*(1), 123–130. https://doi.org/10.7752/JPES.2020.01016
66. Young, L., O'Connor, J., & Alfrey, L. (2020). Physical literacy: A concept analysis. *Sport, Education and Society, 25*(8), 946–959. https://doi.org/10.1080/13573322.2019.1677586