A needs assessment of mobile fitness technology integration in elementary Physical Education

Una evaluación de necesidades sobre la integración de la tecnología móvil de fitness en la Educación Física de primaria

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Received: 03-12-25
Accepted: 14-01-26

How to cite in APA

Husein Allsabah, M. A., Sugito, S., Weda, W., Nugroho, F. T., & Arifin, M. A. N. (2026). A needs assessment of mobile fitness technology integration in elementary Physical Education. *Retos, 75*, 939-949. https://doi.org/10.47197/retos.v76.118276

Abstract

Introduction: The study examined the use of mobile fitness tools in elementary physical education, noting that their success depended on contextual conditions. However, little was known about whether students, teachers, parents, and school infrastructure were ready to support such integration.
Objective: The objective of this study was to assess multi-stakeholder readiness for integrating mobile fitness tools in a typical Indonesian elementary school context.
Methodology: A sequential exploratory mixed-methods design was used. Three physical education lessons were observed using an adapted momentary time sampling protocol. Semi-structured interviews were conducted with teachers, parents, and school leaders. A parental readiness questionnaire was developed and validated through expert review and refined based on qualitative findings.
Results: Students were active for approximately half of the lesson time, with limited movement diversity and minimal equipment use. Parents showed high motivation to support digitally assisted activity, although device access was low and internet connectivity was unstable. Teachers expressed positive attitudes but reported limited digital confidence. Infrastructure constraints emerged as the main barrier to implementation.
Discussion: These results aligned with previous findings showing that unequal device availability, low digital competence, and unstable connectivity reduce the feasibility of digital physical activity programmes in low-resource school environments.
Conclusions: Mobile fitness tools should prioritise low-data, offline-first features and include teacher-support components to enable feasible and equitable implementation.

Keywords

Physical Education; mobile fitness; digital readiness; elementary school; physical activity.

Resumen

Introducción: El estudio examinó el uso de herramientas móviles de fitness en la educación física de primaria, señalando que su éxito dependía de las condiciones contextuales. Sin embargo, se sabía poco sobre si los estudiantes, los maestros, los padres y la infraestructura escolar estaban listos para apoyar dicha integración.
Objetivo: El objetivo era evaluar la preparación de múltiples partes interesadas para integrar herramientas móviles de fitness en el contexto típico de una escuela primaria indonesia.
Metodología: Se utilizó un diseño secuencial exploratorio de métodos mixtos. Se observaron tres lecciones de educación física utilizando un protocolo adaptado de muestreo momentáneo. Se realizaron entrevistas semiestructuradas con maestros, padres y líderes escolares. Se desarrolló un cuestionario de preparación parental, que fue validado mediante revisión de expertos y refinado utilizando hallazgos cualitativos.
Resultados: Los estudiantes estuvieron activos durante aproximadamente la mitad del tiempo de la lección, con una diversidad de movimientos limitada y un uso mínimo de equipos. Los padres mostraron una alta motivación para apoyar la actividad asistida digitalmente, aunque el acceso a dispositivos era bajo y la conectividad a internet era inestable. Los maestros expresaron actitudes positivas pero informaron de una confianza digital limitada. Las limitaciones de infraestructura surgieron como la principal barrera para la implementación.
Discusión: Estos resultados se alinean con hallazgos previos que muestran que la disponibilidad desigual de dispositivos, la baja competencia digital y la conectividad inestable reducen la viabilidad de los programas digitales de actividad física en entornos escolares con pocos recursos.
Conclusiones: Las herramientas de fitness móviles deben priorizar características de bajo consumo de datos y funcionamiento sin conexión, e incluir componentes de apoyo para los profesores para permitir una implementación factible y equitativa.

Palabras clave

Educación Física; fitness móvil; preparación digital; escuela primaria; actividad física.

Introduction

Digital technologies offer extended options for increasing children's physical activity, although their incorporation into school-based physical education (PE) requires alignment with the realities of instructional time, infrastructure, and user capacity. While mobile exercise tools can boost motivation, engagement, and out-of-class activities (Goodyear et al., 2023; Hennessy et al., 2022), evidence remains mixed. Systematic studies consistently reveal that digital PA interventions for children have uneven outcomes when device access is unequal, Wi-Fi connectivity is unstable, or digital literacy varies greatly between users (Ibragimova et al., 2025; Mulato et al., 2024). These constraints are more obvious in low- and middle-income environments, where technical infrastructures are more variable and school-level operational conditions influence feasibility more strongly than in high-resource settings (Lestari et al., 2024; Purwanto et al., 2025).

In Indonesia, inadequate PE instructional time, unpredictability in school resources, and discrepancies in household technology access continue to hamper efforts to promote children's physical activity (Evan, 2024). Many existing mobile fitness programs are built for educational institutions with reliable connectivity, individual device ownership, and strong instructor autonomy circumstances not typically present in Indonesian elementary schools (Mulato et al., 2024). Evidence from Southeast Asian schools shows that digital PA programs often fail to scale when they assume technological capacity that does not reflect local realities (Rabani et al., 2023; Terasawa et al., 2022). Consequently, early-stage readiness assessments that consider multiple stakeholders, students, teachers, parents, and infrastructure are essential to prevent technology–context mismatches that undermine adoption and sustainability (Goodyear et al., 2023; Greenhalgh et al., 2017).

Several recognized implementation and technology-adoption frameworks, including RE-AIM, CFIR, NASSS, and TAM, provide important high-level assistance; nevertheless, these models are not intended especially for the pedagogical, motor-skill, and organizational demands of primary PE. They present basic predictors of adoption but do not address PE-specific concerns such as movement diversity, course pace, instructor digital pedagogy, device-sharing norms, and infrastructural volatility. Recent literature emphasizes that adaptation of such frameworks must be context-driven, especially when applied to situations where instructional procedures and digital capacity vary dramatically (Alberto, 2022; Gomes et al., 2024). In response, the Mobile Fitness Technology–Physical Education (MFT–PE) Readiness Framework employed in this study was conceptually developed from important variables in RE-AIM, CFIR, NASSS, and TAM while restructuring them into readiness indicators relevant to PE contexts. The paradigm stresses contextual aspects such as instructor facilitation capacity, student digital autonomy, movement-task variance, and infrastructure reliability that directly affect the feasibility of mobile fitness integration.

Despite increased interest in digital innovation for PE, empirical preparedness assessments remain restricted, especially in basic settings where device ownership is inconsistent and digital competence is varied. Studies in Asia and Europe suggest that without rigorous studies of readiness across stakeholders, digital PE projects risk reinforcing disparities or imposing excessive demands on instructors (Anthony, 2024; Ermenova et al., 2021; Suherman et al., 2025). However, little is known about how readiness factors interact within a single ecosystem and translate into practical design considerations for mobile fitness applications.

Accordingly, this study intends to undertake a multi-stakeholder needs assessment to evaluate the readiness of students, instructors, parents, and school infrastructure to enable the integration of mobile fitness equipment in Indonesian elementary PE. Consistent with exploratory, design-oriented research, the study does not evaluate intervention effectiveness; rather, it provides contextual evidence to inform early-stage development of culturally grounded, structurally feasible mobile fitness applications suitable for low-resource educational environments.

Method

A sequential exploratory mixed-methods design was used to examine contextual readiness for integrating mobile fitness technology into elementary physical education (PE). Qualitative insights informed the

development and refinement of quantitative instruments, and both strands were merged during interpretation to ensure comprehensive coverage of student, teacher, parent, and school-level conditions.

Participants

The study was conducted in a public elementary school located in an urban district of East Java, Indonesia, chosen because it reflects typical PE teaching conditions in Indonesian primary schools: limited instructional time, uneven digital access, and changing infrastructural reliability. Participants comprised 28 students aged 10–11 years, one PE instructor, one school administrator, and 20 parents. Although the student sample is limited, it is methodologically acceptable for an exploratory mixed-methods needs assessment, since the purpose is rich contextual understanding rather than statistical generalization. The incorporation of formal observations, semi-structured interviews, and parental questionnaires further increases data depth and reliability. All identifying details are withheld to ensure participant confidentiality.

Procedure

Data collection consisted of three sequential components: structured observations, semi-structured interviews, and a parental readiness questionnaire. This sequence allowed qualitative findings to inform questionnaire refinement and provided multi-level triangulation across stakeholders.

1. Structured Classroom Observation

Three PE lessons (70–90 minutes each) were observed using an adapted SOFIT (System for Observing Fitness Instruction Time) momentary time sampling procedure. Observations aimed to document students' physical activity levels, variation in motor tasks (movement diversity), instructional organization, and teacher prompts related to movement. The observation protocol included 20-second momentary time sampling and five SOFIT activity categories: lying down, sitting, standing, walking, and vigorous activity. Additional descriptive indicators included movement diversity (locomotor, manipulative, stability tasks), availability of equipment, organizational format, and teacher prompts encouraging activity. Two trained observers independently coded all sessions after completing a calibration exercise using sample video scenarios. Inter-observer agreement was substantial (Cohen's $\kappa = 0.84$).

2. Semi-Structured Interviews

Semi-structured interviews were conducted to contextualize observation results and explore the readiness of teachers, parents, and school leaders for digital integration in PE. Interviews with the PE teacher and school administrator lasted 25–35 minutes, while a parent group interview lasted approximately 30 minutes. All interviews were audio-recorded with consent and transcribed verbatim. Topics included instructional constraints, teacher digital literacy, parental expectations and concerns, infrastructure conditions, and perceptions of feasibility and value of mobile fitness applications.

Instrument

Observation Instrument

An adapted SOFIT observation protocol was used, incorporating standard activity categories and additional descriptive indicators such as movement diversity, equipment availability, organizational format, and teacher prompts. Analytic computation included "active time" (walking and vigorous activity) and "movement diversity" (number of distinct motor actions per lesson).

Interview Guide

Semi-structured interview guides were used for teachers, school leaders, and parents, focusing on instructional constraints, digital capacity, parental support, infrastructure readiness, and perceived feasibility of mobile fitness integration.

Parental Readiness Questionnaire

A 20-item Likert-scale questionnaire was administered to assess parental digital readiness, focusing on device availability, internet stability, supervision of digital use, perceived usefulness of mobile fitness applications, and willingness to support technology-assisted physical activity. Items were adapted from WHO digital readiness indicators and refined based on qualitative findings on device-sharing routines, inconsistent internet access, parental safety concerns, and expectations regarding school-based digital

programs. Content validity was assessed by three experts in PE technology and digital pedagogy (I-CVI = 0.67–1.00; items < 0.78 revised; S-CVI/Ave = 0.90).

Data analysis

Qualitative Analysis

Interview data were analysed using inductive–deductive thematic analysis, progressing through open, axial, and selective coding phases. Two researchers independently coded the data (κ = 0.82), with memo-writing supporting analytic decisions. Emergent codes were organised into five readiness domains: instructional constraints, teacher digital capacity, student digital affinity, parental support, and infrastructure support.

Observation Analysis

SOFIT categories were converted into percentage scores to represent activity patterns. "Active time" was calculated as the combined proportion of walking and vigorous activity, while "movement diversity" reflected the number of distinct motor tasks observed per lesson. Quantitative results were interpreted alongside qualitative field notes.

Quantitative Survey Analysis

Survey data were analysed using descriptive statistics, including means, standard deviations, and frequencies. No cut-off thresholds were applied, as the aim was to identify readiness trends rather than classify readiness levels.

Integration of Data

A convergent triangulation strategy was used to integrate observational findings, interview themes, parental survey indicators, and contextual readiness domains. An integrated joint display was employed to connect findings across stakeholders.

Results

All results presented below are descriptive and derived directly from observations, interviews, and survey data, without interpretative claims.

1. Physical Activity Patterns

Across the three observed PE lessons, a total of 540 intervals were recorded. Students were active for 45% of lesson time, consisting of walking (28%) and vigorous activity (17%). Sitting (20%) occurred primarily during instruction, while standing (25%) reflected transitions and waiting turns. These activity distributions are presented in Table 1.

Table 1. Distribution of SOFIT Activity Categories

Category	Percentage	Notes
Lying	1%	Rare occurrence
Sitting	20%	During instructions
Standing	25%	Transitions and waiting
Walking	28%	Main low-intensity activity
Vigorous Activity	17%	High-intensity segments
Active Time	45%	Walking + vigorous
Sedentary Time	21%	Sitting + lying

2. Movement Diversity

Motor-task variety during lessons was limited. Activities were dominated by basic locomotor movement (walking circuits) and repetitive throw–catch drills, with minimal stability tasks and no technology-based motor tasks observed. Key data indicators are summarised in Table 2 to complement the descriptive findings above.

Table 2. Observed Movement Types and Frequencies

Activity Type	Presence	Notes
Walking circuits	High	Repeated across sessions
Throw–catch drills	High	Low variation
Running drills	Low	Space constraints
Digital tasks	None	No device-based learning

3. Student Digital Affinity

Students demonstrated familiarity with mobile phones mainly for entertainment. No student-initiated or independent device use was observed in PE lessons. Interviews confirmed that students required assistance when navigating beyond simple video content.

Representative excerpts:

"They usually ask for help when using apps other than YouTube." (Parent)

"They can follow a short exercise video, but only if the teacher plays it." (Teacher)

Key data indicators are summarised in Table 3 to complement the descriptive findings above.

Table 3. Indicators of Student Digital Affinity

Source	Evidence
Teacher interview	"Students follow simple video instructions."
Observation	"Students did not handle devices during lessons."
Parent interview	"Children mostly use phones for games or videos."
Parent interview	"My child needs help navigating apps."

4. Teacher Digital Capacity

The teacher used basic smartphone features such as taking photos, setting timers, and playing short videos, but no mobile fitness or educational applications were integrated into instruction. Interviews indicated limited prior training in digital PE tools.

As the teacher expressed:

"I can use the basic functions, but I've never been trained to use apps for PE activities."

Key data indicators are summarised in Table 4 to complement the descriptive findings above.

Table 4. Teacher Digital Capacity Indicators

Indicator	Evidence (Data Only)
Device use in lessons	Photos and a stopwatch were used; no apps.
Digital navigation skills	Able to operate basic smartphone features.
Training	No prior training in digital PE tools.
Teacher statement	"I've never been trained to use apps for PE activities."

5. Parental Support

Survey findings (n = 20) indicated strong parental motivation to support technology-assisted PE. Perceived usefulness (M = 4.20) and willingness to accompany children (M = 4.20) were high, while screen-time concerns were moderate (M = 3.40).

Representative excerpt:

"I can assist my child as long as there are clear instructions."

Key data indicators are summarised in Table 5 to complement the descriptive findings above.

Table 5. Parental Support Indicators (Survey)

Item	Mean	SD
Perceived usefulness	4.20	0.55
Willingness to accompany	4.20	0.60
Support for digital PE	4.05	0.58
Safety/screen concerns	3.40	0.65

6. Infrastructure Readiness

Infrastructure constraints appeared consistently across data sources. Observations noted unstable Wi-Fi during video demonstrations, the absence of charging points around the PE field, and families relying on shared devices with limited mobile data.

Representative excerpts:

"The Wi-Fi sometimes turns off in the middle of class." (Teacher)

"We share one phone, so my child cannot always use it." (Parent)

Key data indicators are summarised in Table 6 to complement the descriptive findings above.

Table 6. Infrastructure Constraints

Source	Evidence
Observation	"Wi-Fi disconnected during video loading."
School leader	"Field has no charging outlets."
Parent	"We rely on mobile data only."
Parent	"Phone is shared among family members."

7. Integrated Readiness Overview

Triangulation of all data sources revealed clear readiness patterns across stakeholders:

- High parental motivational readiness,
- Moderate student digital familiarity,
- Moderate teacher digital capacity,
- Low instructional readiness for technology-enhanced PE, and
- Very low infrastructure readiness.

These readiness levels correspond directly to the five domains of the MFT–PE Readiness Framework developed for this study, and a consolidated overview is provided in Table 7.

Table 7. Summary of Readiness Levels Across Stakeholder Domains

Readiness Domain	Indicator Source(s)	Evidence Summary	Readiness Level
Parental Support	Survey, interview	High perceived usefulness; willingness to accompany activities; moderate safety concerns	High
Student Digital Affinity	Interview, observation	Familiar with entertainment apps; limited use of educational/fitness apps	Moderate
Teacher Digital Capacity	Interview, observation	Able to use basic phone functions; no experience with digital PE apps; no training	Moderate
Instructional Readiness	Observation, interview	Lessons dominated by simple tasks; no digital integration; time constraints	Low
Infrastructure Support	Observation, interview, parent survey	Unstable Wi-Fi; shared devices; limited mobile data; no charging access	Very Low

Discussion

The outcomes of this study show the complex interplay between motivational readiness, digital competence, and structural constraints in influencing the feasibility of mobile fitness technology integration in

basic PE. Although students and parents exhibited favourable dispositions toward technology, the instructional and infrastructural constraints surrounding PE sessions considerably constrained opportunities for digital-supported exercise. These patterns match broader conclusions in PE literature, where enthusiasm alone does not achieve significant adoption without alignment between user capability and contextual realities (Bogdanovskaya & Andreichenko, 2024; Lolowang, 2025).

The students exhibited a moderate level of digital affinity, characterised by familiarity with entertainment-oriented smartphone applications rather than educational or fitness-related tools. Comparable research has shown that general digital fluency among children does not necessarily translate into effective engagement with structured learning applications, particularly when navigation demands exceed their autonomous skill levels (Fadhli et al., 2023). The absence of student-initiated device use during physical education suggests that the integration of mobile fitness tools will require explicit scaffolding, demonstration, and teacher-guided utilisation. This finding supports the view that app-based physical education initiatives must accommodate developmental constraints through simplified interfaces and teacher-mediated routines. Recent evidence from school-based physical education contexts further indicates that introducing digital tools without age-appropriate design and instructional mediation tends to position students as passive users rather than active participants in movement-based learning tasks (Shekerbekova et al., 2025).

The teacher's digital capacity constituted an additional constraint. The instructor demonstrated competence in basic smartphone functions, such as photography and timer use, but lacked experience with physical education–specific applications and had not received formal training. This gap is consistent with prior research indicating that teacher confidence, rather than device access alone, is a critical determinant of successful digital integration in physical education (Maquera-Maquera, 2025). In CFIR terms, this reflects a weakness within the “Inner Setting” domain, particularly limited technical resources and insufficient opportunities for professional development. Without targeted digital pedagogy training, even motivated teachers may struggle to translate technology into meaningful instructional practice. Systematic reviews in physical education similarly highlight that limited pedagogical readiness often results in technology being used primarily as a supplementary display tool rather than as an integrated component of movement-based learning (Al Ardha et al., 2024).

Instructional readiness was also low, characterised by limited movement diversity and considerable passive time. Prior work warns that digital interventions in PE should not be introduced into instructional environments already constrained in activity variability and task design (Romero-Rodríguez et al., 2024). If underlying pedagogical structures remain narrow, the addition of technology risks reinforcing passive patterns rather than expanding active engagement. The current context, therefore, suggests that foundational improvements in task variety and time allocation should accompany technological adoption.

Parental support, on the other hand, appeared as a preparedness strength. Parents praised the promise of mobile fitness tools and reported a desire to support their children, even while noting hazards connected with screen time. Recent evidence indicates that family involvement considerably boosts the success of home-extended PA programs, particularly when digital content is offered in short, structured formats (Cahyati et al., 2024). Family-based PA research further shows that when parents perceive digital tools as easy to supervise and low-risk, their engagement tends to increase, creating more consistent reinforcement of children’s physical activity routines (Brennan et al., 2025). In low-resource contexts, parental encouragement often compensates for limited school infrastructure, making families an essential component of digital PA adoption (Lane et al., 2021). The high motivation observed among parents in this study suggests strong potential for hybrid school-home activity loops, provided that tasks remain accessible and bandwidth is light.

Infrastructure readiness represented the most substantial barrier. Unstable Wi-Fi, reliance on shared devices, and limited mobile data are all consistent with infrastructural challenges widely documented in Indonesian schools and other low-resource environments (Henjilito et al., 2024). Studies across Southeast Asia similarly report that infrastructural volatility, particularly inconsistent connectivity and device rotation among family members, significantly reduces the feasibility of digital learning tools, including those targeting physical activity (Presta et al., 2024; Rizal et al., 2019). From a NASSS perspective, this positions mobile fitness tools as "contextually fragile": technically feasible but highly sensitive to environmental instability. As such, an offline-first, low-data, lightweight design becomes a practical

necessity. Research on digital deployment in rural and peri-urban schools reinforces that offline functionality, minimal storage requirements, and low processing demand are key predictors of successful adoption (Wallace et al., 2023). Schools with inconsistent connectivity require tools that minimise dependence on streaming, frequent updates, or device-specific capabilities.

Together, these findings reflect a readiness profile in which motivational elements (students and parents) are supportive, while capability- and resource-based elements (teachers, instruction, infrastructure) are constraining. This distribution resembles the "asymmetrical readiness" pattern described in implementation research, where favourable attitudes coexist with structural barriers that limit actual uptake (Mali et al., 2023). Within the RE-AIM framework, this translates into strong "Reach" potential but weaker "Adoption" and "Implementation" prospects unless contextual supports are strengthened.

For mobile fitness innovation, these findings underscore the need for solutions that minimise teacher burden and maximise simplicity. Prior research warns that PE teachers typically reject technologies that add extra workload or require complex operational steps (Nurul et al., 2022). Hence, future prototypes should emphasise intuitive navigation, low-setup routines, and automatic cueing features that reduce instructional management overhead. Aligning these design principles with teacher workflows improves the likelihood of sustained use.

Finally, while the readiness framework proposed in this study provides a structured lens for interpreting multi-stakeholder conditions, it remains conceptual rather than validated. Its strength lies in integrating contextual, motivational, and infrastructural considerations in a way that reflects real-world PE constraints. However, larger multi-site trials are needed to examine its generalisability, refine its components, and test its predictive value for technology adoption. Future research should also explore how readiness levels evolve as teachers receive training and as tools are iteratively improved.

Overall, the discussion suggests that integrating mobile fitness technology in elementary PE is promising but not yet fully feasible under current conditions. Success will depend on addressing infrastructural limitations, strengthening teacher capacity, and ensuring that digital tools are purposefully designed for low-resource educational environments. These insights provide a grounded basis for developing and piloting a simplified, context-sensitive intervention in future work.

Conclusions

This study provides a cautious but informative overview of an elementary school's contextual readiness to integrate mobile fitness technology into Physical Education. Across multiple data sources, motivational readiness among students and parents emerged as a consistent strength, indicating a favourable foundation for future technology-supported activity initiatives. However, limited teacher digital capacity, narrow instructional routines, and substantial infrastructural constraints collectively suggest that the school environment is not yet fully prepared for implementation. These findings reinforce that successful integration of mobile fitness tools requires alignment between motivational factors and the structural, pedagogical, and organisational conditions that enable meaningful use.

As an exploratory needs assessment, this study identifies priority areas for improvement, particularly infrastructural stability, teacher professional development, and lesson design, before more advanced stages of intervention development or pilot testing can be undertaken. Future work should focus on co-designing low-bandwidth, teacher-friendly prototypes and conducting multi-school readiness assessments to ensure that subsequent mobile fitness interventions are feasible, contextually grounded, and sustainable in low-resource educational settings.

Acknowledgements

The authors wish to extend their heartfelt gratitude to the principal, teachers, students, and parents of the partner elementary school for their significant involvement and support during the needs assessment process. Their willingness to collaborate, share insights, and maintain an open dialogue significantly enhanced the development of this study. The authors express appreciation to the academic su-

pervisors and colleagues for their valuable feedback, which significantly enhanced the clarity and direction of this work. Gratitude is expressed to Universitas Nusantara PGRI Kediri for their academic guidance and institutional support, which were instrumental in the successful completion of this study.

Financing

This study was financially supported by the Directorate of Research, Technology, and Community Service (DRTPM), Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia, under the 2025 DRTPM grant scheme.

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