

# Reimagining Physical Education Curriculum in the Digital Era: Integrating Technology, Active Learning, and Value-Based Models

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## Abstract

**Background of study:** Rapid digital developments demand a transformation in Physical Education (PE) curricula, especially at the primary level, where traditional approaches often fail to integrate digital literacy and character-based learning effectively.

**Aims and scope of paper:** This study aims to develop and evaluate a PE curriculum prototype for elementary schools in the digital era by integrating technology, active learning, and the AKIDAH model (Analytical, Creative, Islamic, Demonstrative, Active, Humanistic).

**Methods:** Using Design-Based Research (DBR), the study involved validation by 7 experts, implementation by 15 teachers, and field trials with 120 elementary students. Data were collected via expert validation sheets, observation rubrics, and student questionnaires, then analyzed using descriptive statistics and paired t-tests.

**Results:** The curriculum demonstrated strong validity (71.43% expert agreement) and significantly improved student engagement (+34%,  $p < 0.001$ ), motor skills (+27%,  $p < 0.012$ ), and digital literacy (+31%,  $p < 0.001$ ).

**Conclusion:** The integration of digital tools and character-based models is effective in PE, aligning with constructivist learning theories and providing a validated prototype ready for digital-era elementary education.

**Keywords:** Akidah Model; Curriculum Development; Digital Literacy; Elementary School; Physical Education

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## INTRODUCTION

The rapid advancement of digital technology has fundamentally transformed the global educational landscape (Hassan, 2023). Technology is no longer viewed merely as an optional supplementary tool but has become an integral and inescapable component of modern learning environments. This shift demands a continuous adaptation of pedagogical strategies across all academic disciplines to ensure that educational institutions remain relevant to the needs of 21st-century learners (Soghomonyan & Karapetyan, 2023).

Within the specific domain of physical education (PE), this technological evolution presents unique opportunities to enrich instructional practices. Contemporary innovations, ranging from gamification elements to fundamental artificial intelligence applications, have the potential to significantly drive student activity and motivation (Suresh Babu & Dhakshina Moorthy, 2024). These digital interventions can transform traditional athletic drills into dynamic, data-informed learning experiences that resonate with digitally native students.

Despite these advancements, physical education at the elementary school level frequently remains entrenched in conventional pedagogical models (Li & Zhang, 2024). Instructional delivery often relies heavily on repetitive, teacher-centered drills with minimal to no integration of technological tools. This stagnation creates a widening gap

between the formal school curriculum and the highly digitized daily lives of young students, leading to decreased interest and participation (Alencar et al., 2024).

Integrating technology into physical education presents a distinct pedagogical challenge that differs from classroom-based subjects. Educators must navigate the delicate balance of utilizing digital devices without inadvertently reducing the actual time students spend engaged in physical activity. The primary objective of PE must remain centered on psychomotor development, meaning technology should serve as a cognitive scaffold rather than a sedentary distraction (Di et al., 2025).

When implemented effectively, however, digital tools offer substantial benefits for motor skill acquisition and student engagement (Mueller & Wagner, 2026). Previous studies have consistently highlighted that interactive media and digital platforms can facilitate immediate, augmented feedback, allowing students to observe and correct their movement errors in real-time. Such integration promotes a more autonomous and analytical approach to physical movement (Feng & Song, 2025).

While the theoretical benefits of technology in PE are increasingly recognized, there is a distinct lack of actionable frameworks for primary education (Martín-Rodríguez & Madrigal-Cerezo, 2025). Comprehensive curriculum prototypes that explicitly guide elementary school teachers on how to merge digital literacy with physical activity remain conspicuously scarce in the current literature. This absence leaves educators without clear, evidence-based blueprints for modernizing their physical education syllabi.

To address this critical gap, this study proposes the implementation of a physical education curriculum prototype grounded in the AKIDAH model. Representing a framework that is Analytical, Creative, Islamic, Demonstrative, Active, and Humanistic, this model offers a holistic pedagogical approach tailored specifically to the cultural and educational context of Indonesia. It seeks to harmonize the demand for digital competence with the essential task of character building (Herak, 2025).

The central purpose of this research is to rigorously validate this newly developed AKIDAH-based curriculum prototype. By conducting structured field testing, the study aims to measure the curriculum's direct effectiveness in improving three pivotal outcomes: student engagement levels, fundamental motor skill proficiency, and foundational digital literacy among elementary school students.

## METHODS

This study employed the Design-Based Research (DBR) approach, a systematic yet flexible methodology aimed at improving educational practices through iterative analysis, design, development, and implementation. In accordance with the Standards for Reporting Qualitative Research (SRQR) for its qualitative components, the research was conducted over a six-month period from January to June 2025. The DBR process was executed in four integrated phases: initial problem analysis, curriculum prototype development, iterative field testing, and a final comprehensive evaluation.

The participants were selected using a purposive sampling technique to ensure the involvement of individuals with specific expertise and relevance to the research objectives (Tajik et al., 2025). The sample included seven experts specialized in physical education pedagogy, educational technology, and character education for the validation phase. For the implementation stage, 15 PE teachers from five public elementary schools were involved, along with 120 students from grades IV and V (aged 9–11 years), with an equal distribution of 60 male and 60 female students. All participating schools were equipped

with basic digital infrastructure, such as tablets and internet access, to support the curriculum's technology-integrated framework.

The primary instrument of this research was the AKIDAH-based curriculum prototype, which follows a structured 70-minute pedagogical sequence across 16 sessions. Data collection involved four specialized tools: expert validation sheets using a 1–5 Likert scale, student engagement observation rubrics adapted from Xu et al. (2024), motor skill tests based on the TGMD-3, and a digital literacy questionnaire. To ensure the validity and reliability of these instruments, they underwent rigorous expert judgment and pilot testing before actual field use. A sample interview or reflection question included in the process was: *"How does the integration of QR codes specifically facilitate your independent movement during the practice session?"*

The analysis plan integrated both quantitative and qualitative techniques. Quantitative data were processed using SPSS version 26, employing descriptive statistics (mean and standard deviation) and paired t-tests to evaluate significant changes in student outcomes before and after the curriculum implementation. The validity of the prototype was established based on a threshold of at least 70% expert agreement. Qualitatively, feedback from teachers and students was analyzed to refine the prototype during the iterative cycles.

The scope and limitations of this methodology are focused on the integration of Islamic and humanistic values within a digital PE framework. While the DBR approach provides high internal validity for the specific context of the participating schools, the findings primarily serve as a prototype for digital-era PE and may require further adaptation for broader multicultural or non-religious educational settings (McKenney & Reeves, 2021).

## RESULTS AND DISCUSSION

### Results and Discussion

The evaluation of the curriculum prototype began with a rigorous expert validation process involving seven specialists across pedagogy and technology domains. The findings, as summarized in Table 1, indicated a high level of overall validity with a mean score of 71.43%.

Table 1. Expert Validation Results

Indicator	Score (%)	Category
Clarity of representation (curriculum overview)	85.71%	Highly Valid
Clarity of definition for each component	71.43%	Valid
Distinction from traditional PE curricula	57.14%	Fair (Revised)
Relevance to digital era and character education	71.43%	Valid
Overall Average	71.43%	Valid

Following the validation, the eight-week implementation involving 120 students yielded significant quantitative improvements. As shown in Table 2, statistical analysis using paired t-tests confirmed that all measured variables experienced substantial gains ( $p < 0.05$ ).

Table 2. Pre-test and Post-test Results of Curriculum Implementation (n=120)

Variable	Pre-test Mean	Post-test Mean	Improvement (%)	t-value	p-value
Student Engagement (Scale 0–100)	58.2	78.0	+34%	8.45	< 0.001
Motor Skills (Scale 0–100)	62.5	79.4	+27%	3.92	12
Digital Literacy (Scale 0–20)	9.7	12.7	+31%	7.21	< 0.001

Qualitative feedback further corroborated these findings. Table 3 highlights how students and teachers perceived the integration of the AKIDAH model and digital tools in the field.

Table 3. Summary of Qualitative Feedback from Teachers and Students

Theme	Sub-theme	Description	Representative Quotes
Student Engagement	Active Participation	Increased enthusiasm and active involvement.	"Previously passive students became highly active once they held the tablet." (Teacher 3)
Digital Integration	Autonomy & Efficiency	Facilitated independent learning and saved prep time.	"QR code stations saved my prep time. Students could learn independently." (Teacher 9)
Value Internalization	Character Building	Fostered meaningful moral and Islamic reflection.	"The honesty and sportsmanship reflection is unique and meaningful." (Teacher 12)

The significant increase in student engagement (+34%) underscores the effectiveness of the AKIDAH model in transforming the pedagogical landscape of elementary physical education. By positioning technology as a "cognitive scaffolding" rather than a replacement for physical movement, this curriculum aligns perfectly with constructivist learning theories.

Furthermore, the incorporation of interactive multimedia, specifically through QR code stations, facilitates highly effective differentiated instruction. In a primary education setting, students naturally possess varying baseline motor skills and cognitive processing speeds. By utilizing digital devices to access instructional videos independently, students are empowered to review complex movement sequences at their own pace without peer pressure. This self-paced, technology-driven approach accommodates diverse learning profiles and fosters self-regulated learning habits from an early age, effectively shifting the traditional teacher-centered pedagogical model toward a more autonomous, student-centric ecosystem. These results resonate with the findings of Müller and Wagner (2025), which emphasize that digital tools can drastically enhance participation rates among young learners.

Beyond cognitive and psychomotor enhancements, the AKIDAH model uniquely bridges the critical gap between technological exposure and moral education. The qualitative feedback emphasizing meaningful reflections on honesty and sportsmanship illustrates that digital platforms can effectively serve as reflective mediums. The structured integration of Islamic and humanistic values ensures that students do not merely interact with technology mechanically, but use it to document and articulate their ethical decision-making during physical activities. This deliberate curriculum design guarantees that the digitalization of elementary education amplifies, rather than diminishes, the fundamental objective of holistic character development.

Furthermore, the 27% improvement in motor skills provides empirical support for the use of *augmented feedback* in primary education. The integration of video analysis allowed students to visualize their movement errors in real-time, a process that Davids et al. (2013) identify as crucial for effective skill acquisition. Interestingly, the simultaneous 31% increase in digital literacy demonstrates that PE can serve as a dual-purpose platform, fulfilling UNESCO's mandate to integrate digital competencies across all subject areas.

Fostering digital literacy within physical education dismantles the traditional, siloed approach to technology integration often prevalent in primary curricula. When students actively utilize tablets for practical, context-rich tasks such as recording peer movements for analysis or navigating applications to access augmented feedback they transition from passive consumers of screen time to critical users of digital tools (Pellas, 2026). This multimodal learning experience synthesizes physical exertion with technological navigation, proving that interactive media can be seamlessly embedded into kinesthetic environments to yield comprehensive, cross-disciplinary skill acquisition (Guo, 2025).

### **Implications**

The findings of this study carry significant pedagogical implications for primary physical education. By demonstrating that digital literacy and motor skill acquisition can occur simultaneously, this research challenges the traditional dichotomy that views screen time as inherently antithetical to physical activity. Educators can leverage digital scaffolds such as augmented video feedback and QR code stations to facilitate differentiated, self-paced learning. This approach accommodates the varying baseline skills and learning speeds typical of elementary students, ultimately shifting the instructional paradigm from a uniform, teacher-directed model toward an autonomous, student-centric kinesthetic environment.

Beyond psychomotor and cognitive development, the successful implementation of the AKIDAH model provides a practical blueprint for value internalization in the digital age. The curriculum illustrates that technological integration does not necessitate the abandonment of character education. Instead, digital platforms can serve as reflective mediums where students articulate and document their ethical decision-making, such as displaying honesty and sportsmanship during activities. This alignment ensures that the modernization of physical education remains firmly anchored in fundamental Islamic and humanistic principles, achieving a truly holistic educational experience.

On a systemic and practical level, these results signal a pressing need for institutional shifts regarding resource allocation and teacher training. For school administrators and curriculum policymakers, adopting this digital-era prototype requires a continuous commitment to providing foundational infrastructure, including reliable internet access and accessible devices like tablets. Furthermore, professional development programs must be reconceptualized to equip physical education teachers with both the

technical proficiency and the pedagogical confidence required to seamlessly weave digital tools into active movement lessons without compromising the core objective of physical health.

### **Research Contribution**

This study significantly advances the existing body of literature by presenting a validated, character-integrated framework that successfully merges digital technology with elementary physical education. By conceptualizing technology as a cognitive scaffold rather than a sedentary replacement for movement, this research provides robust empirical evidence supporting constructivist learning theories within active kinesthetic environments. Furthermore, it validates the AKIDAH model, addressing a critical gap in contemporary curriculum design by proving that technological transformation can be effectively balanced with the strengthening of character and religious values. The research demonstrates how moral reflection rooted in Islamic and humanistic principles can be seamlessly cultivated alongside physical activity, ensuring that fundamental character building is amplified rather than marginalized by the introduction of digital tools.

Practically, the research equips educators and instructional designers with a rigorous, field-tested blueprint that simultaneously improves student engagement, motor skills, and digital literacy. By demonstrating that physical education can effectively operate as a dual-purpose pedagogical platform, the study fulfills broader global educational mandates to embed digital competencies across all academic disciplines. Ultimately, it establishes a foundational reference point for future research and policy development, offering a comprehensive model to modernize primary physical education for the digital era without compromising its core kinesthetic and ethical objectives

### **Limitations**

Despite the significant outcomes observed, this research presents several methodological constraints. The eight-week implementation duration captures the immediate efficacy of the curriculum prototype but remains insufficient to evaluate the long-term retention of the acquired motor skills and digital competencies. Establishing whether the observed increases in student engagement are sustained over an entire academic year requires a longitudinal research design. Furthermore, the reliance on pre-test and post-test measurements without a distinct randomized control group limits the ability to fully isolate the curriculum's impact from typical developmental variables and external factors influencing elementary students.

An additional limitation involves the specific demographic and theoretical context of the intervention. The AKIDAH model explicitly incorporates Islamic values as a core component of its character-building framework. While this approach proved highly relevant and effective for the specific context of the participating schools, it inherently restricts the direct generalizability of the findings to secular institutions or more diverse demographic populations. Consequently, applying this curriculum prototype to broader multicultural or non-religious educational settings will necessitate careful pedagogical adaptation to ensure the value internalization components resonate across different cultural backgrounds

### **Suggestions**

Future research should build upon these initial findings by employing more rigorous experimental methodologies. Specifically, the implementation of randomized controlled trials (RCTs) with distinct experimental and control groups is highly recommended to isolate the curriculum's pedagogical effects and establish definitive causal relationships.

Additionally, transitioning from short-term implementations to longitudinal studies would provide critical insights into the long-term retention of the acquired motor skills, the sustainability of heightened student engagement, and the lasting impact of digital literacy integration over an extended academic period.

Furthermore, subsequent studies must address the contextual boundaries of the current framework by exploring the model's adaptability across diverse multicultural and non-religious educational settings. Researchers should investigate how the core character-building components of the curriculum can be effectively translated or modified to align with universal ethical principles, ensuring broader applicability. Investigating the prototype's efficacy across different elementary grade levels and in schools with varying degrees of technological infrastructure would also significantly enhance the scalability and generalizability of this digital-era physical education model.

## CONCLUSION

This research successfully developed and evaluated a Physical Education (PE) curriculum prototype based on the AKIDAH model, specifically designed for the digital era in elementary schools. The findings demonstrate that the curriculum is highly valid, achieving a 74.3% expert agreement score, and effectively improves key educational outcomes. The implementation led to significant gains in student engagement (+34%), motor skills (+27%), and digital literacy (+31%). Theoretically, this study reinforces the constructivist perspective by proving that digital technology can be seamlessly integrated into physical activity as a cognitive tool without diminishing the essence of movement. Practically, the AKIDAH model provides a holistic framework that balances technological transformation with the strengthening of character and religious values.

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## AUTHOR CONTRIBUTIONS AND DECLARATIONS

PI designed the research, developed the AKIDAH model theoretical framework, analyzed the data, and drafted the initial manuscript. GJ contributed to the data collection process, conducted the literature review, and performed the final manuscript editing and proofreading.

All authors have read and approved the final version of the manuscript. All authors have confirmed that this work is original, free from plagiarism (with a similarity index of no more than 15%), complies with ethical standards, and that they are fully prepared to accept any consequences in the event of a violation of these provisions.

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