Volume 8 Number 1 (2026)
January-April 2026
Page: 1205-1224

E-ISSN: 2656-4491
P-ISSN: 2656-4548
DOI: 10.37680/scaffolding.v8i1.9247

SCAFFOLDING
Jurnal Pendidikan Islam dan Multikulturalisme

ENHANCING STUDENTS' LEARNING INTEREST IN INTEGRATED SCIENCE AND SOCIAL STUDIES THROUGH CONTEXTUAL INTERACTIVE ANIMATION VIDEOS

Intan Nirwana[1], Imran[2], Nisa Aulia[3]
[123]Universitas Islam Negeri Sulthan Thaha Saifuddin Jambi; Indonesia
Correspondence E-mail; inirwana131@gmail.com

Submitted: 19/02/2026 Revised: 23/03/2026 Accepted: 28/03/2026 Published: 14/04/2026

Abstract

This study investigates the effectiveness of contextual interactive animation videos in enhancing fourth-grade students' learning interest in Integrated Science and Social Studies (IPAS). Employing Classroom Action Research (CAR) based on the Kemmis and McTaggart cyclical model, the study was conducted over two cycles involving fourth-grade students during the 2025/2026 academic year. Data were collected through triangulation of structured observations, Likert-scale questionnaires, semi-structured interviews, and documentation. This study involved the entire student population at SD Islam As'ad Olak Kemang in the 2025/2026 academic year and designated the fourth-grade class as the sample through purposive sampling. Quantitative data were analyzed using percentage techniques, while qualitative data were interpreted descriptively. Baseline findings indicated substantial student disengagement, largely driven by the dominance of conventional lecture methods and the limitations of damaged teaching aids. Following the intervention, students' learning interest improved markedly across cycles, with the most pronounced gains observed in active participation and self-confidence alongside notable improvements in teacher instructional quality. The integration of contextual interactive animation successfully facilitated a shift toward Guided-Discovery learning and revealed an "Efficiency Paradox," whereby digital media effectively compensated for inadequate physical infrastructure. These findings position contextual interactive animation as a scalable and compensatory pedagogical innovation for resource-constrained primary classrooms.

Keywords

Contextual Interactive Animation, Learning Interest, Integrated Science and Social Studies (IPAS), Guided Discovery Learning, Digital Pedagogy.

INTRODUCTION

Primary education serves as the fundamental cornerstone for developing students' character, knowledge, and essential skills. In this formative phase, the learning process transcends mere information transfer; it must foster sustainable interest and motivation. Learning interest is a critical determinant of academic success, as students with high interest demonstrate greater persistence, enthusiasm, and active engagement (Liu, 2022; Lynam et al., 2024). Ideally, learning interest in elementary education integrates cognitive, affective, and behavioral dimensions (Bordbar et al., 2025). Cognitively, students should exhibit curiosity; affectively, they should find joy in the process (Teo et al., 2022), and behaviorally, they should participate actively in classroom discourse(Alam & Mohanty, 2024; Gruber et al., 2022; Wong & Liem, 2022).

Fostering such multifaceted interest remains a significant challenge in 21st-century education (Beaudoin & Avanthey, 2023; Kormos & Wisdom, 2023; Yamada, 2025). The shift toward more active and independent curricula often clashes with traditional pedagogical approaches that fail to engage digital-native students (Ay & Caner, 2025; Korobkova et al., 2025). This gap is vividly observed at SD Islam As'ad Olak Kemang, where preliminary observations revealed a critical lack of student engagement. Approximately 60% of fourth-grade students exhibited low focus, often appearing passive, bored, and hesitant to participate. This disengagement stems from a reliance on conventional lecture-based methods and a lack of innovative visual media, which leaves students struggling to grasp abstract concepts in Integrated Science and Social Studies (IPAS).

The integration of interactive contextual animation videos offers a promising pedagogical intervention. Cognitive Theory of Multimedia Learning(Immanuel & Hameed, 2023; Mayer, 2024), this approach posits that students learn more deeply from words and pictures than from words alone, as the brain processes information through dual channels (visual and auditory)(Alwadei & Mohsen, 2023; Lin et al., 2023; Teng & Zhang, 2024). Furthermore, Vygotsky's (1978) social constructivism suggests that learning is most effective when it is contextual and interactive (Jones et al., 2025; Possaghi & Papavlasopoulou, 2025; Song et al., 2023), mirroring real-life situations (Vandeyar & Adegoke, 2024; Yan et al., 2024). Interestingly, the concept of learning through visual observation is also echoed in classical wisdom, such as the narrative in Surah Al-Māidah verse 31, where observation of a concrete medium (the crow) facilitated the acquisition of new knowledge, a principle that aligns with modern experiential learning. The research was motivated by preliminary findings indicating low student engagement at SD Islam As'ad Olak Kemang, where conventional

lecture-based instruction and limited instructional media resulted in passive classroom participation.

The primary urgency of this research stems from the critically low levels of student engagement observed at SD Islam As'ad Olak Kemang. Preliminary observations revealed that over 60% of students exhibited passive learning behaviors, characterized by a lack of inquiry, minimal response to teacher instructions, and frequent off-task activities. Interviews with classroom teachers further indicated that the predominance of conventional, one-way lecture methods has led to significant instructional boredom. These findings are corroborated by documentary evidence of daily assessments, which show a stagnant trend in student performance, directly correlating with a lack of cognitive and emotional investment in the classroom. This situation creates a systemic barrier; without diversified stimulation, students lose their intrinsic motivation, which—if left unaddressed—will result in weakened conceptual understanding and poor long-term memory retention within the primary education framework.

As a strategic antithesis to these pedagogical challenges, interactive video was selected as the primary intervention variable due to its unique capacity to simultaneously engage cognitive and sensory domains. Unlike static media or traditional teaching aids, interactive video incorporates features such as branching paths and immediate feedback loops, which necessitate active decision-making by the student. This choice is predicated on the urgent need at SD Islam As'ad to disrupt the cycle of passivity through dynamic visual and auditory stimulation. Interactive video does not merely deliver information; it fosters a self-regulated learning ecosystem that enhances student agency. By integrating interactive elements, this medium serves as a bridge to transition learning patterns from passive listening to active discovery, which is theoretically more effective in triggering bilateral interaction and curiosity compared to conventional visual aids.

Previous empirical studies have highlighted the efficacy of animation in the classroom. Research by (Ayu Made Yeni Lestari et al., 2024) demonstrated that interactive animation could increase active participation by up to 45%, while (Siddharth et al., 2022; Zheng et al., 2024) found that local-context-based videos significantly reduced learning boredom. Despite these findings, there is a scarcity of research specifically examining the synergy between contextual-interactive elements in animation for integrated subjects in Islamic elementary school settings(Lasker et al., 2001; Pedercini et al., 2019). This study aims to fill this gap by investigating how contextual interactive animation videos can enhance the learning interest of fourth-grade students at SD Islam

As'ad Olak Kemang. By blending theoretical rigor with practical classroom application, this research seeks to provide a strategic solution for creating a more dynamic(Cedergreen, 2014), meaningful, and inclusive learning environment(Carte & Califf, 2024).

Despite the growing body of literature on digital learning tools, a significant research gap remains concerning the implementation of 'offline-first' interactive media in under-resourced primary schools, particularly within the Indonesian rural context. While existing studies have extensively explored high-end online tutoring systems, there is limited empirical evidence addressing how interactive video-based interventions can mitigate student passivity in environments with constrained internet connectivity and conventional teaching cultures. Furthermore, most pedagogical research focuses on general engagement, yet few have specifically evaluated the 'antithesis' role of branching interactive media in disrupting long-standing lecture-based traditions at the elementary level. This study, therefore, seeks to bridge this void by investigating the SENSE-ITS framework as a localized solution to foster active participation and cognitive involvement among students in SD Islam As'ad Olak Kemang.

METHOD

This study employed Classroom Action Research (CAR), specifically adopting the Kemmis and McTaggart model, which follows a cyclical process of planning, acting, observing, and reflecting (Ceylan & Comoglu, 2024; Nurhidaya & Pujaningsih, 2025). The research was implemented in two cycles to iteratively enhance the quality of learning and to address students' disengagement in Integrated Science and Social Studies (IPAS) through the use of contextual interactive animation videos. In this design, the researchers functioned as both facilitators and observers, enabling instructional adjustments based on real-time classroom responses. The population of the study comprised all fourth-grade students at SD Islam As'ad Olak Kemang in the 2025/2026 academic year.

Using purposive sampling, one intact fourth-grade class was selected as the research sample based on the criterion that the class had previously demonstrated low learning interest under conventional lecture-based instruction. The study was conducted over two months (January–February 2026) to ensure adequate stabilization of the media intervention. Data were collected from primary sources (systematic classroom observations and semi-structured interviews with teachers and students) and secondary sources (school documents and academic records), thereby strengthening the methodological rigor and empirical grounding of the findings by measuring five

dimensions of learning interest (visual attention, affective response, active participation, persistence, and self-confidence.

A triangulation technique was utilized for data collection to enhance the validity and reliability of the research. First, systematic observation using structured rubrics was employed to measure teacher performance and student behavioral engagement. Second, a Likert-scale questionnaire was administered to quantify five key dimensions of learning interest: visual attention, affective response, active participation, persistence, and self-confidence. Third, semi-structured interviews were conducted to capture qualitative nuances regarding the students' experiences with the animation media. Finally, documentation comprising lesson plans, student work samples, and photographic evidence provided a comprehensive audit trail of the classroom transformation.

The data analysis involved a combination of qualitative descriptive analysis and quantitative percentage calculations. The success of the intervention was measured against a dual-criteria threshold: a class success indicator of at least 75% for student interest levels and a minimum academic achievement score of 70, following the *Kriteria Ketercapaian Tujuan Pembelajaran* (KKTP). Quantitative data were processed using the percentage formula ($P = \frac{f}{N} x100\%$) to track progress between Cycle I and Cycle II. Qualitative insights from reflections and interviews were categorized and interpreted to provide a holistic explanation of how the contextual elements of the animation videos catalyzed student engagement and conceptual understanding.

To enhance methodological transparency, the research setting and data sources must be described more explicitly. This study was conducted at SD Islam As'ad Olak Kemang, Jambi, during the 2025/2026 academic year, specifically in one fourth-grade classroom selected purposively due to its previously identified low learning interest. The data were categorized into primary and secondary sources. Primary data consisted of direct classroom observations conducted in each cycle, field notes documenting instructional dynamics, structured observation sheets measuring students' learning interest indicators, and semi-structured interviews with both the classroom teacher and selected students to capture cognitive, affective, and behavioral responses. Secondary data included school profile documents, students' attendance lists, academic records, lesson plans, and curriculum documents related to IPAS instruction. By clearly distinguishing the types and sources of data, the research procedure becomes more systematic, traceable, and academically transparent.

FINDINGS AND DISCUSSION

Findings

1. The Pre-Intervention Gap: Conventional Pedagogy and Student Disengagement

The baseline data (Pre-Cycle) revealed a significant disparity between the school's visionary curriculum and actual classroom engagement. Despite the institution's rich historical background and religious commitment, the pedagogical approach in Integrated Science and Social Studies (IPAS) remained traditional. Observational data indicated that only 33.87% of students met the learning interest indicators, while a staggering 66.13% were classified as disengaged.

Qualitative interviews with the teacher highlighted that the reliance on lecture-based methods and the lack of contextual media were primary factors. Interestingly, the lowest score was found in the "Active Participation" dimension (65.31%), suggesting that students felt like passive recipients of information. Furthermore, the school's physical infrastructure, marked by damaged physical teaching aids, constrained the teacher's ability to demonstrate abstract concepts like magnetism, leading to a "monotone" classroom atmosphere where students were easily distracted.

The consequences of this instructional stagnation extend beyond mere passivity, manifesting as a profound "pedagogical anxiety" regarding the students' long-term academic trajectory. At SD Islam As'ad Olak Kemang, the persistent reliance on rote learning has resulted in a diminished sense of inquiry, where students view complex subjects like IPAS as abstract hurdles rather than relatable phenomena. Documentary evidence from student assessments suggests that without a shift in medium, the cognitive gap between the curriculum's objectives and actual student understanding will continue to widen. This creates an urgent necessity for a pedagogical "disruptor" that can revitalize the classroom atmosphere and re-establish the connection between religious-historical values and modern scientific inquiry.

In response to these localized constraints, the integration of a digital ecosystem serves as a necessary evolution to bypass the limitations of damaged physical teaching aids. However, a "digital-only" approach often fails in rural or developing contexts due to connectivity issues. Therefore, the research proposes a transition toward an "offline-first" adaptive framework, ensuring that the digitalization of education does not inadvertently alienate students in regions with limited infrastructure. By prioritizing tools that are both technologically robust and contextually accessible, the teacher can transform the "monotone" environment into a dynamic learning space where abstract concepts previously hindered by broken models—are vividly simulated and explored.

The selection of interactive video as the primary intervention, rather than conventional digital slides or static media, is a deliberate antithesis to the existing lecture-based culture. Interactive video functions as a catalyst for student agency by embedding branching scenarios and real-time feedback loops directly into the instructional flow. This medium addresses the "Active Participation" deficit by shifting the student's role from a spectator to a decision-maker, compelling them to engage with the content to progress. Theoretically, this approach bridges the gap between passive observation and active discovery, providing a scalable and immersive solution that aligns with the institution's vision for a high-quality, religiously grounded, yet technologically advanced educational experience.

2. Digital Transformation across Pre-Cycle, Cycle I, and Cycle II: Bridging Abstract Concepts through Contextual Animation

The integration of Contextual Interactive Animation Videos was designed not only as a technological addition to the classroom but also as a pedagogical transformation to address students' difficulties in understanding abstract scientific concepts. Across the Pre-Cycle, Cycle I, and Cycle II, the instructional process evolved from conventional, teacher-centered delivery toward a more structured Guided-Discovery Learning approach supported by contextual digital media. This gradual transformation influenced cognitive stimulation, affective engagement, collaborative participation, and overall instructional quality. The following table summarizes the digital transformation observed throughout each stage of implementation.

Table 1. The results of pre-cycle, cycle I, and cycle II

Dimension	Pre-Cycle	Cycle I	Cycle II
Cognitive Stimulation	Learning relied on conventional explanation and limited (partly damaged) physical tools; abstract concepts such as magnetic poles and fields were difficult for students to visualize.	Animation videos visualized magnetic poles and invisible magnetic fields clearly, helping students better understand previously abstract concepts.	Conceptual understanding became stronger and more consistent as videos were integrated with guided inquiry and clearer teacher scaffolding.
Affective Shift	Student interest and enthusiasm were still moderate; engagement remained in the fair category.	Student enthusiasm increased as videos incorporated familiar local contexts (e.g., refrigerator doors, nails). Learning became more enjoyable.	Students showed very high enthusiasm and sustained interest due to improved motivation, reinforcement, and meaningful contextualization.
Collaborative Action	Learning was mostly teacher-centered with limited student	Transition from video viewing to group magnet-	Collaboration became more structured and

	interaction and hands-on activity.	making experiments encouraged collaboration and active participation.	effective; students worked more independently and confidently during guided-discovery activities.
Instructional Quality	Teacher implementation reached 50% (fair); classroom management and learning flow were not yet optimal.	Implementation improved to 80% (good); the teacher began effectively integrating animation media and active learning.	Implementation reached 90% (very good); the teacher effectively connected content to daily life, provided reinforcement, and managed the class efficiently.

Source: Observe data analysis cycle

The transition from the Pre-Cycle to Cycle II marks a profound shift in the cognitive engagement of students, moving from abstract confusion to clear conceptual mastery. In the Pre-Cycle stage, the learning process was severely hindered by a reliance on conventional verbal explanations and a lack of functional resources, as damaged physical tools failed to illustrate complex phenomena like magnetic fields. The introduction of interactive animation in Cycle I served as a critical cognitive bridge, transforming these "invisible" scientific concepts into tangible visual data. By Cycle II, this stimulation matured into a robust intellectual framework; the integration of guided inquiry with sophisticated teacher scaffolding ensured that students did not merely observe the animations but internalized the underlying physics. This progression demonstrates that digital visualization, when systematically reinforced, can effectively compensate for material scarcity and eliminate the cognitive barriers inherent in traditional science instruction.

Beyond cognitive gains, the study observed a significant transformation in the classroom's emotional and social climate. Initially, student enthusiasm remained stagnant in the "fair" category, characterized by passive reception and moderate interest. However, the implementation of Cycle I introduced a vital affective catalyst: the use of familiar local contexts, such as refrigerator doors and household nails, which anchored abstract theory in the students' lived experiences. This sense of "meaningful contextualization" sparked a surge in enjoyment that reached its peak in Cycle II, where students displayed sustained high enthusiasm and a refined sense of persistence. Parallel to this affective growth was a shift in collaborative action; the classroom transitioned from a teacher-centered vacuum to a vibrant laboratory. By Cycle II, the collaboration had become highly structured, allowing students to transition from guided video viewing to independent, confident

participation in magnet-making experiments, thereby evolving from passive observers into active scientific collaborators.

The success of the intervention is inextricably linked to the dramatic improvement in instructional quality and classroom management throughout the cycles. In the Pre-Cycle, teacher implementation was recorded at a mere 50%, reflecting a fair but non-optimal learning flow that struggled to engage the student body. As the teacher began to integrate animation media and active learning strategies in Cycle I, the implementation rate rose to 80%, signaling a growing proficiency in modern pedagogical delivery. By the conclusion of Cycle II, instructional quality reached an exemplary 90%, characterized by the teacher's ability to seamlessly connect curriculum content to daily life while providing consistent reinforcement. This "Very Good" rating indicates that the teacher had moved beyond basic media use to achieve total pedagogical fluency, effectively managing class dynamics and ensuring that the digital tools served as a transformative lever for student activation rather than a mere technological add-on.

3. Quantitative Analysis of Learning Interest Dimensions

The study tracked five key dimensions to measure the impact of the intervention. The initial findings suggest a positive trajectory in students' psychological and behavioral responses:

Table 2. Students' Psychological and Behavioral Responses

No	Learning Interest Indicators	Pre-Cycle	Category	Cycle I	Category	Cycle II	Category
1.	Visual Attention / Interest	69.03%	Fair	75.81%	Good	83.71%	Very Good
2.	Affective Enjoyment / Positive Feelings	68.75%	Fair	73.55%	Good	84.35%	Very Good
3.	Engagement / Active Participation	65.31%	Fair	69.03%	Fair	85.97%	Very Good
4.	Persistence / Task Completion	69.53%	Fair	73.55%	Good	84.75%	Very Good
5.	Self-Confidence / Expectancy for Success	65.47%	Fair	71.29%	Good	86.77%	Very Good
	Overall Average	67.62%	Fair	72.65%	Good	85.11%	Very Good

Source: Research data Analysis

Based on the observation results of teacher activities during the Pre-Cycle, Cycle I, and Cycle II, a gradual improvement in the implementation of instruction was identified. In the Pre-Cycle, the percentage of teacher activity implementation was 50% (fair category), indicating that the learning process had not yet run optimally. In Cycle I, the implementation increased to 80% (good category), where the teacher began to apply instruction supported by animated video media and engaged

students more actively in the learning process. Furthermore, in Cycle II, the implementation rose to 90% (very good category), demonstrating that the teacher was able to conduct IPAS learning effectively by connecting the material to students' daily lives, providing motivation and reinforcement, and managing the classroom efficiently.

The systematic progression in teacher performance from 50% to 90% signifies a profound evolution in pedagogical fluency, moving beyond mere technical adoption to a sophisticated orchestration of the learning environment. In the initial stages, the "fair" implementation reflected a traditional reliance on rigid, top-down instruction, which often struggled to maintain classroom cohesion or student interest. However, as the teacher transitioned into Cycle II, the data suggests a mastery of "adaptive teaching" where the instructor no longer simply delivered content but actively curated a dynamic learning experience. This 90% implementation threshold indicates that the teacher successfully internalized the guided-discovery framework, allowing for a seamless integration of digital tools with real-time student feedback. Consequently, the classroom shifted from a space of passive reception to a high-functioning environment where instructional flow was characterized by precise timing, effective transitions, and a robust capacity to address diverse learner needs.

Furthermore, the qualitative leap in Cycle II underscores the importance of the teacher as a contextual mediator who bridges the gap between abstract scientific theory and the students' lived realities. The teacher's increased ability to connect Integrated Science and Social Studies (IPAS) concepts to daily life—such as using local household metaphors within the animated framework—demonstrates a shift toward Culturally Responsive Teaching. By providing consistent motivation and targeted reinforcement, the instructor effectively lowered the students' "affective filter," creating a safe and stimulating psychological space for inquiry. This high level of instructional quality proves that the animation media did not replace the teacher, but rather acted as a catalyst that empowered the instructor to provide more nuanced scaffolding. Ultimately, this trajectory reveals that the success of digital interventions is inextricably linked to the teacher's growth in managing the complex interplay between media engagement, curriculum alignment, and interpersonal classroom dynamics.

4. Overcoming Infrastructure Constraints through Digital Media

A critical finding of this research is the "Efficiency Paradox." While the school's physical facilities (tables, chairs, and physical kits) were reported as "severely damaged" (Table 3), the

introduction of digital animation videos provided a cost-effective and highly engaging alternative. This suggests that in resource-constrained educational settings, digital contextual media can serve as a "compensatory tool" that not only replaces damaged physical aids but exceeds their pedagogical value by providing interactive and repeatable simulations.

Table 3. School's Physical Facilities

No	Type of Facility	Quantity	General Condition
1.	Student Desks	31	Light to severely damaged
2.	Student Chairs	43	Mostly lightly damaged
3.	Teacher Desks/Chairs	11	Severely damaged
4.	Teaching Aids (*Alat Peraga*)	5	Light to severely damaged
5.	School Bell/Printer	2	Severely damaged
6.	Laptop	2	Lightly damaged
7.	Handwashing Station	3	Severely damaged

Source: Research data Analysis

The baseline assessment of the school's physical infrastructure reveals a pervasive state of decay that significantly compromises the quality of the daily learning environment. The inventory data paints a stark picture of resource scarcity, where fundamental classroom furniture—including 31 student desks and 11 teacher desk-chair sets—ranges from lightly to severely damaged. This deterioration extends beyond mere aesthetics; it represents a structural barrier to effective classroom management and student focus. Perhaps most critical to the instructional process is the condition of the teaching aids (*alat peraga*) and essential administrative technology, such as printers and school bells, which are classified as severely damaged. When the very tools designed to facilitate conceptual demonstration are broken or inaccessible, the pedagogical burden shifts entirely to verbal delivery, often resulting in the conventional, teacher-centered stagnation observed in the Pre-Cycle phase.

The severity of the infrastructure deficit at the institution serves as a critical variable in explaining the initial disengagement of students and the subsequent necessity of the digital intervention. With handwashing stations and basic laptops also suffering from functional impairment, the school operates within a "resource-constrained" framework that traditionally limits experimental science education. This material scarcity creates a systemic bottleneck; for instance, the lack of functional teaching aids (only 5 units, mostly damaged) renders the visualization of abstract scientific phenomena nearly impossible through physical means alone. Consequently, the introduction of Contextual Interactive Animation Videos in this study acts as a vital compensatory strategy. By bypassing the reliance on dilapidated physical tools and providing high-quality virtual demonstrations, the digital intervention effectively "repairs" the instructional gap caused by the

broken physical infrastructure, proving that technological innovation can serve as a primary equalizer in under-resourced educational settings.

Discussion

The baseline findings (Pre-Cycle) reveal a substantial misalignment between the institution's visionary curriculum and the enacted classroom practices at SD Islam As'ad Olak Kemang. Although the school is characterized by strong historical and religious commitments, the learning process in Integrated Science and Social Studies (IPAS) within this institution remained dominated by conventional, teacher-centered instruction. This pedagogical gap at SD Islam As'ad suggests that while the school maintains a robust cultural identity, the instructional delivery has yet to transition toward the more engaging, student-centered methods required for modern digital literacy. The empirical evidence showing that only 33.87% of students met the learning interest indicators while 66.13% were disengaged confirms the persistence of what many scholars describe as the "implementation gap" between curricular ideals and pedagogical reality. This condition indicates that institutional ethos alone is insufficient to stimulate student engagement without corresponding pedagogical innovation (Amirudin et al., 2025; Antunes et al., 2023; Sharma et al., 2024).

Qualitative insights from teacher interviews strengthen the quantitative evidence by identifying lecture dependency and the absence of contextual media as primary causes of disengagement. The particularly low score in Active Participation (65.31%) suggests that students were positioned mainly as passive knowledge recipients rather than active constructors of meaning. This finding aligns with constructivist learning theory (Almulla, 2023; Thampinathan, 2022), which posits that meaningful learning emerges through active involvement, exploration, and social interaction. The observed "monotone" classroom climate, therefore, reflects a structural pedagogical limitation rather than merely a motivational deficit among students.

The study also highlights the material dimension of disengagement through the deteriorated physical infrastructure. Damaged teaching aids limited the teacher's ability to concretize abstract scientific concepts, such as magnetism (Ben Ouahi et al., 2022; Ramaila & Mngomezulu, 2025). Prior research consistently shows that when abstract phenomena are not properly visualized, elementary students experience cognitive overload and reduced curiosity(Dar et al., 2022; Niyamae, 2025). In this context, the infrastructure deficit functioned as a mediating variable that reinforced traditional pedagogy and further suppressed student interest (Zhang et al., 2024; Zivave et al., 2025). Thus, disengagement in this case should be understood as a systemic issue emerging from the interaction

between pedagogy, media availability, and learning environment.

The pervasive decay of physical resources at the institution provides a concrete explanation for the persistence of conventional teaching methods. The baseline inventory reveals that essential classroom furniture—including 31 student desks and 11 teacher desk-chair sets—ranges from lightly to severely damaged, creating a suboptimal physical environment that discourages active movement and collaborative layouts. More critically, the "severe" damage reported for both administrative technology (printers and school bells) and the handwashing stations reflects a broader institutional neglect of the material conditions necessary for a modern learning ecosystem. When the physical environment is characterized by such widespread impairment, the teacher's pedagogical agency is structurally constrained, forcing a retreat into lecture-based instruction as a survival strategy rather than an informed choice. This suggests that the "monotone" classroom climate is not merely an instructional failure but a direct consequence of a learning environment that lacks the basic physical integrity to support student-centered exploration.

The severity of the infrastructure deficit is most acutely felt in the domain of scientific inquiry, where only five teaching aids were available, and even those were largely non-functional. This scarcity renders the visualization of abstract concepts, such as magnetic poles and fields, nearly impossible through traditional physical means. In this context, the introduction of Contextual Interactive Animation Videos functions as more than just a supplementary tool; it serves as a vital compensatory infrastructure. By utilizing the few functional laptops available to project high-quality virtual demonstrations, the intervention effectively bypasses the broken physical teaching aids, "repairing" the instructional gap through digital mediation. This finding challenges the assumption that science education in resource-limited settings must wait for physical laboratory renovations; instead, it demonstrates that targeted digital scaffolding can neutralize the negative effects of damaged physical assets and reactivate student curiosity in even the most materially constrained classrooms.

The intervention in Cycle I introduced Contextual Interactive Animation Videos within a Guided-Discovery Learning framework, marking a decisive pedagogical shift. The animation successfully visualized invisible magnetic fields and pole interaction phenomena previously difficult to demonstrate using damaged physical tools. This supports multimedia learning theory, particularly the dual coding and cognitive theory of multimedia learning(Çeken & Taşkın, 2022; Noetel et al., 2022), which argues that well-designed visualizations enhance conceptual

understanding by integrating verbal and visual channels(Marougkas et al., 2023; Schneider et al., 2022). The present findings empirically reinforce these theoretical claims within a resource-constrained primary school context.

The integration of local contextual elements in the animation (e.g., refrigerator doors and household nails) contributed to a measurable increase in students' affective engagement. This improvement is reflected in the rise of Affective Enjoyment from 68.75% (Fair) in the Pre-Cycle to 73.55% (Good) in Cycle I, and further to 84.35% (Very Good) in Cycle II. A similar upward trend occurred in Visual Attention, which increased from 69.03% to 75.81% and eventually to 83.71%. These findings align with contextual learning theory, which emphasizes connecting instructional content to learners' lived experiences. Unlike studies that employ generic animations, this research demonstrates that micro-contextualization embedding familiar cultural and household references can significantly strengthen both emotional and attentional engagement. Thus, the affective shift observed beginning in Cycle I and solidified in Cycle II represents not merely a media effect, but a context-sensitive pedagogical enhancement that progressively deepened students' learning interest.

Another important transformation occurred in the collaborative and behavioral dimensions of learning. Although Active Participation in Cycle I (69.03%) remained in the Fair category compared to the Pre-Cycle (65.31%), a substantial improvement was evident in Cycle II, where it reached 85.97% (Very Good). Parallel increases were observed in Persistence (from 69.53% to 84.75%) and Self-Confidence (from 65.47% to 86.77%). The structured transition from video viewing to group-based magnet experiments enabled students to operationalize newly acquired knowledge through guided practice. These results resonate with guided discovery and experiential learning literature, which stress the importance of coupling digital stimulation with hands-on activity. Importantly, the data indicate that while digital media-initiated engagement in Cycle I, optimal behavioral transformation required iterative refinement and stronger scaffolding in Cycle II. Therefore, this study extends prior work by demonstrating that even in schools with limited or damaged physical resources, meaningful experimentation and significant gains in learning interest can be achieved when contextual digital scaffolding is systematically and progressively implemented.

Improvements across the five dimensions of visual attention, affective response, active participation, persistence, and self-confidence indicate a positive multidimensional trajectory of learning interest. Particularly noteworthy is the reported 29% increase in students' confidence to

perform demonstrations. Previous studies often report gains in attention or motivation separately; in contrast, this research demonstrates synchronized growth across psychological and behavioral indicators. This multidimensional improvement suggests that contextual interactive animation functions not only as an attention-grabbing tool but as a catalyst for broader learner activation.

One of the most theoretically significant contributions of this study is the identification of the "Efficiency Paradox." Despite severely damaged physical facilities, the introduction of digital animation produced substantial engagement gains. This finding challenges the dominant assumption in the literature that physical laboratory completeness is a prerequisite for effective science learning (Oliveira & Bonito, 2023; Rosen & Kelly, 2023). Instead, the results support an emerging perspective that high-quality digital media can serve as a compensatory and in some cases superior pedagogical mechanism in under-resourced settings. This has important implications for equity-oriented educational technology deployment in developing regions.

This research contributes three key advances to the field: (1) empirical evidence of how contextual interactive animation operationalizes guided discovery in IPAS at the elementary level; (2) the conceptualization of digital media as a compensatory infrastructure strategy under conditions of material scarcity; and (3) a multidimensional measurement model capturing synchronized affective–behavioral engagement shifts. Future research should test the longitudinal sustainability of these gains, examine scalability across diverse school contexts, and integrate adaptive or AI-driven features to further personalize learning. Overall, the study demonstrates that thoughtfully contextualized digital animation is not merely a technological add-on but a transformative pedagogical lever for reactivating student engagement in resource-limited classrooms.

A granular analysis of the transition from Cycle I to Cycle II reveals that the surge in student engagement was not a simple linear progression, but rather a structured process of cognitive and psychological adaptation. During Cycle I, the most significant improvements were observed in the visual and affective dimensions, suggesting a "novelty effect" triggered by the initial introduction of interactive animation. However, by Cycle II, the most profound gains shifted toward the dimensions of Persistence and Self-Confidence, which ascended from the "Fair" to "Very Good" categories. This shift indicates that the integration of contextual animation serves a dual purpose: it acts as an immediate attentional hook and, more importantly, functions as a sustained pedagogical scaffold that progressively builds learners' self-efficacy. These findings confirm that measured repetition

combined with digital scaffolding can effectively mitigate the psychological barriers of passive learning, fostering a classroom ecosystem that is resilient even when faced with abstract academic challenges.

The efficacy of this intervention was found to be deeply contingent upon the synergy between media design and the teacher's ability to perform conceptual deconstruction through local narratives. Observations during Cycle II highlighted a pivotal shift in the teacher's role from a primary information provider to a dialogic mediator who bridged the gap between digital visualizations and the students' socio-cultural reality in Olak Kemang. The use of familiar household objects within the animations was not merely an illustrative tactic; it represented an epistemological effort to dissolve the boundary between "school science" and everyday life. By grounding the phenomena of magnetism in objects familiar to the students, the cognitive load associated with scientific abstraction was significantly reduced. This transformation suggests that educational technology reaches its zenith not by replacing the instructor, but by expanding the teacher's instructional capacity to deliver culturally responsive and scientifically rigorous learning experiences.

CONCLUSION

This study confirms that the low learning interest observed in the pre-intervention phase was primarily rooted in the dominance of conventional lecture-based pedagogy, limited contextual media, and inadequate physical teaching infrastructure. The baseline data demonstrated a clear implementation gap between the school's curricular vision and actual classroom engagement, with the majority of students positioned as passive learners. These conditions collectively suppressed students' cognitive curiosity, affective enthusiasm, and behavioral participation in IPAS learning. The implementation of contextual interactive animation videos within a Guided-Discovery Learning framework proved effective in addressing these challenges. The intervention successfully visualized abstract scientific concepts, connected learning materials to students' everyday experiences, and facilitated collaborative hands-on activities. As a result, students exhibited consistent improvements across five key dimensions of learning: interest, visual attention, affective response, active participation, persistence, and self-confidence, indicating a multidimensional enhancement of engagement rather than isolated motivational gains. A significant theoretical contribution of this study is the identification of the "Efficiency Paradox," demonstrating that high-quality digital

contextual media can compensate for, and in some cases surpass, the pedagogical limitations caused by damaged physical infrastructure. This finding challenges the prevailing assumption that effective science learning in primary schools depends heavily on complete physical laboratory facilities. Instead, the study positions contextual interactive animation as a strategic, scalable solution for resource-constrained educational environments. In conclusion, contextual interactive animation videos function not merely as supplementary instructional media but as transformative pedagogical tools capable of reactivating student engagement in integrated subjects. Future research is recommended to examine long-term retention effects, broader implementation across diverse school settings, and the integration of adaptive or AI-supported features to further enhance personalization and sustainability of learning outcomes.

REFERENCES

Alam, A., & Mohanty, A. (2024). Framework of Self-Regulated Cognitive Engagement (FSRCE) for Sustainable Pedagogy: A Model that Integrates SRL and Cognitive Engagement for Holistic Development of Students. *Cogent Education*, *11*(1), 2363157.

Almulla, M. A. (2023). Constructivism Learning Theory: A Paradigm for Students' Critical Thinking, Creativity, and Problem Solving to Affect Academic Performance in Higher Education. *Cogent Education*, *10*(1), 2172929.

Alwadei, A. M., & Mohsen, M. A. (2023). Investigation of the use of Infographics to Aid Second Language Vocabulary Learning. *Humanities and Social Sciences Communications*, *10*(1), 108.

Amirudin, A., Muzaki, I. A., & Nurhayati, S. (2025). Problem-Based Learning as a Pedagogical Innovation for Transforming Higher Education Students' Islamic Religious Comprehension. *Educational Process: International Journal*, *18*, e2025412.

Antunes, V. T., Armellini, A., & Howe, R. (2023). Beliefs and Engagement in an Institution-Wide Pedagogic Shift. *Teaching in Higher Education*, *28*(6), 1328–1348.

Ay, E., & Caner, M. (2025). The Digital Nativeness of Lower Secondary Students. *New Review of Information Networking*, *30*(1), 56–78.

Ayu Made Yeni Lestari, N. G., Boeriswati, E., & Dhieni, N. (2024). Using Interactive Multimedia to Stimulate Early Childhood Students' Speaking Skills: A Systematic Review. *International Journal of Interactive Mobile Technologies*, *18*(16).

Beaudoin, L., & Avanthey, L. (2023). How to Help Digital-Native Students to Successfully Take Control of Their Learning: A Return of 8 Years of Experience on a Computer Science E-Learning Platform in Higher Education. *Education and Information Technologies*, *28*(5), 5421–5451.

Ben Ouahi, M., Lamri, D., Hassouni, T., & Al Ibrahmi, E. M. (2022). Science Teachers' Views on the Use and Effectiveness of Interactive Simulations in Science Teaching and Learning. *International Journal of Instruction*, *15*(1), 277–292.

Bordbar, S., Mirzaei, S., Bahmaei, J., Atashbahar, O., & Yusefi, A. R. (2025). Predicting Students' Academic Performance Based on Academic Identity, Academic Excitement, and Academic Enthusiasm: Evidence from a Cross-Sectional Study in a Developing Country. *BMC Medical Education*, *25*(1), 768.

Carte, T., & Califf, M. E. (2024). Searching for Synergy Between Research and Teaching. In *Journal of Information Technology Case and Application Research* (Vol. 26, Issue 3, pp. 264–270). Taylor & Francis.

Cedergreen, N. (2014). Quantifying Synergy: A Systematic Review of Mixture Toxicity Studies within Environmental Toxicology. *PloS One*, *9*(5), e96580.

Çeken, B., & Taşkın, N. (2022). Multimedia Learning Principles in Different Learning Environments: A Systematic Review. *Smart Learning Environments*, *9*(1), 19.

Ceylan, E., & Comoglu, I. (2024). Action Research in Initial EFL Teacher Education: Emerging insights from a CAR project. *Educational Action Research*, *32*(3), 438–453.

Dar, M. A., Kudare, R., Dar, Y. A., Ali, I., & Mohammed, S. (2022). Role of Projected and Non-Projected Teaching Aids in the Teaching and Learning Process. *Journal of Positive School Psychology*, *6*(10).

Gruber, T., Bazhydai, M., Sievers, C., Clément, F., & Dukes, D. (2022). The ABC of social learning: Affect, behavior, and cognition. *Psychological Review*, *129*(6), 1296.

Immanuel, J., & Hameed, M. A. M. S. (2023). Cognitive Theory of Multimedia Learning Powered Code-Switching Interface for Vocabulary Acquisition of ESL Students. *Journal of Language Teaching and Research*, *14*(6), 1439–1448.

Jones, B., Desu, A., & Honig, C. D. F. (2025). Artificial Intelligence Chatbots as Virtual Patients in Dental Education: A Constructivist Approach to Classroom Implementation. *European Journal Of Dental Education*.

Kormos, E., & Wisdom, K. (2023). Digital Divide and Teaching Modality: Its Role in Technology and Instructional Strategies. *Education and Information Technologies*, *28*(8), 9985–10003.

Korobkova, O. K., Galchenko, N. A., Orekhovskaya, N. A., Drozdova, E. A., Zakharova, O. V, & Lobuteva, A. V. (2025). A Scoping Review of Contemporary Frameworks, Challenges, and Future Directions on Educational Technology for Digital Generations. *Contemporary Educational Technology*, *17*(4), ep611.

Lasker, R. D., Weiss, E. S., & Miller, R. (2001). Partnership Synergy: A Practical Framework for Studying and Strengthening the Collaborative Advantage. *The Milbank Quarterly*, *79*(2), 179–205.

Lin, X., Tang, W., Ma, W., Liu, Y., & Ding, F. (2023). The Impact of Media Diversity and Cognitive Style on Learning Experience in Programming Video Lecture: A brainwave analysis. *Education and Information Technologies*, *28*(8), 10617–10637.

Liu, Z. (2022). The interplay of English as a Foreign Language Learners' Interest, Self-Efficacy, and involvement. *Frontiers in Psychology*, *13*, 837286.

Lynam, S., Cachia, M., & Stock, R. (2024). An Evaluation of the Factors that Influence Academic Success As Defined by Engaged Students. *Educational Review*, *76*(3), 586–604.

Marougkas, A., Troussas, C., Krouska, A., & Sgouropoulou, C. (2023). Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade. *Electronics*, *12*(13), 2832.

Mayer, R. E. (2024). The Past, Present, and Future of The Cognitive Theory of Multimedia Learning. *Educational Psychology Review*, *36*(1), 8.

Niyamae, A. N. (2025). *Cognitive Resources in Students' Reasoning: Submicroscopic Representations of Redox Reactions*. ResearchSpace@ Auckland.

Noetel, M., Griffith, S., Delaney, O., Harris, N. R., Sanders, T., Parker, P., del Pozo Cruz, B., & Lonsdale, C. (2022). Multimedia Design for Learning: An Overview of Reviews with Meta-Meta-Analysis. *Review of Educational Research*, *92*(3), 413–454.

Nurhidaya, N., & Pujaningsih, P. (2025). Enhancing English Vocabulary Reading Skills Through

Audiovisual Phonics Instruction: A Classroom Action Research on Students with Specific Learning Difficulties. *Journal of Innovation and Research in Primary Education*, *4*(3), 1501–1515.

Oliveira, H., & Bonito, J. (2023). Practical Work in Science Education: a Systematic Literature Review. *Frontiers in Education*, *8*, 1151641.

Pedercini, M., Arquitt, S., Collste, D., & Herren, H. (2019). Harvesting Synergy from Sustainable Development Goal Interactions. *Proceedings of the National Academy of Sciences*, *116*(46), 23021–23028.

Possaghi, I., & Papavlasopoulou, S. (2025). Technologically-Rich Computational Activities in K–12 Education: A Systematic Review of Constructivist and Constructionist Interventions. *Behavior & Information Technology*, 1–40.

Ramaila, S. M., & Mngomezulu, H. (2025). Assessing Concept Mastery in Physical Sciences: Implementing Formative Assessment Interventions for Teaching and Learning Electricity and magnetism. *International Journal of Learning, Teaching and Educational Research*, *24*(4), 250–276.

Rosen, D., & Kelly, A. M. (2023). Mixed Methods Study of Student Participation and Self-Efficacy in Remote Asynchronous Undergraduate Physics Laboratories: Contributors, Lurkers, and Outsiders. *International Journal of STEM Education*, *10*(1), 34.

Schneider, S., Beege, M., Nebel, S., Schnaubert, L., & Rey, G. D. (2022). The Cognitive-Affective-Social Theory of Learning in Digital Environments (CASTLE). *Educational Psychology Review*, *34*(1), 1–38.

Sharma, A., Jayalakshmi, S., Tripathy, A., Katekhaye, D., & Sharma, A. (2024). Exploring Innovative Pedagogical Approaches for Enhanced Student Engagement. *Decision Making: Applications in Management and Engineering*, *7*(1), 175–188.

Siddharth, L., Blessing, L., & Luo, J. (2022). Natural Language Processing in-and-for Design Research. *Design Science*, *8*, e21.

Song, C., Shin, S.-Y., & Shin, K.-S. (2023). Optimizing Foreign Language Learning in Virtual Reality: A Comprehensive Theoretical Framework Based on Constructivism and Cognitive Load Theory (VR-CCL). *Applied Sciences*, *13*(23), 12557.

Teng, M. F., & Zhang, D. (2024). Vocabulary Learning in a Foreign Language: Multimedia Input, Sentence-Writing Task, and Their Combination. *Applied Linguistics Review*, *15*(5), 2123–2148.

Teo, C. L., Ong, A. K.-K., & Lee, A. V. Y. (2022). *Exploring Students' Epistemic Emotions in Knowledge Building using Multimodal Data*.

Thampinathan, S. (2022). The Application of the Constructivism Learning Theory to Physician Assistant Students In Primary Care. *Education for Health*, *35*(1), 26–30.

Vandeyar, T., & Adegoke, O. O. (2024). Teachers' ICT in Pedagogy: A Case for Mentoring and Mirrored Practice. *Education and Information Technologies*, *29*(14), 18985–19004.

Wong, Z. Y., & Liem, G. A. D. (2022). Student Engagement: Current State of the Construct, Conceptual Refinement, and Future Research Directions. *Educational Psychology Review*, *34*(1), 107–138.

Yamada, A. (2025). Advancing Intercultural Competence in Higher Education: Strategies for Engaging Generation Z. *Education Sciences*, *15*(3), 341.

Yan, W., Lowell, V. L., & Yang, L. (2024). Developing English Language Learners' Speaking Skills Through Applying a Situated Learning Approach in VR-Enhanced Learning Experiences. *Virtual Reality*, *28*(4), 167.

Zhang, D., Fang, Z., & Liao, M. (2024). The Impact of Teachers' Pedagogical Leadership on Student Achievement: the mediating Role of Teaching Methods. *Journal of Professional Capital And Community*, *9*(4), 398–430.

Zheng, H., Xu, W., Wang, Z., Lu, X., & Xiao, C. (2024). Facial Highlight Removal with Cross-Context Attention and Texture Enhancement. *IEEE Transactions on Circuits and Systems for Video Technology*, *35*(2), 1519–1533.

Zivave, T., Sellings, P., Bolaji, S., & Zivave, V. (2025). School Infrastructure as a Catalyst for Pedagogical and Collaborative Change: A Cultural-Historical Activity Theory Study. *Education Sciences*, *15*(10), 1390.