INTERNATIONAL JOURNAL OF RESEARCH AND INNOVATION IN SOCIAL SCIENCE (IJRISS)
ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue XXVI August 2026| Special Issue on Education

The Pedagogical Exploitation of the Interactive Whiteboard in the Teaching of Informatics in Primary School

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DOI: https://doi.org/10.47772/IJRISS.2026.1026EDU0515

Received: 14 August 2026; Accepted: 19 August 2026; Published: 23 August 2026

ABSTRACT

The integration of digital technology into the primary classroom remains a contested pedagogical question. Our study examines how the interactive whiteboard can be exploited as a cognitive tool rather than a simple means of projection. More specifically, we focus on the teaching of Informatics in a primary school, a setting where the device is frequently reduced to a digital replacement for the traditional board. The research adopts an action research design, since the researcher is simultaneously the teacher who plans and delivers the intervention. This dual role allows the investigation of teaching practice from within. Data were collected through a reflective journal, field notes kept during and immediately after each lesson, a short pupil questionnaire supplemented by a group discussion, and samples of pupils' work. The analysis was carried out through thematic analysis. The results suggest that the interactive whiteboard supports engagement and participation, particularly when its interactive and multimedia affordances are deliberately linked to specific cognitive tasks. An important distinction emerged. The device contributes to learning not through its technical features alone but through the pedagogical framing that surrounds its use. Furthermore, our findings indicate that the shift from a presentation tool to a cognitive tool depends on the teacher's planning, the design of the activities, and the degree to which pupils themselves manipulate the interface. We also acknowledge the limitations that the dual role of teacher-researcher introduces, concerning subjectivity and researcher bias, which we addressed through triangulation and reflexivity. This is perhaps the most telling conclusion of our work. The interactive whiteboard is neither inherently transformative nor inherently trivial; its value is constituted in the pedagogical decisions of the teacher. We close with implications for teacher education and for the design of Informatics activities in primary schooling.

Keywords: interactive whiteboard; Informatics education; primary school; cognitive tool; action research

INTRODUCTION

Digital technology has become a familiar presence in the primary classroom. Interactive whiteboards, in particular, have been installed in schools across many educational systems, often with considerable public investment and political enthusiasm (Redman & Vincent, 2015). Yet their pedagogical value is far from self-evident. In everyday practice the interactive whiteboard is frequently used as a large screen for the projection of slides and images, a practice that reproduces teacher-centred instruction rather than transforming it. This gap between availability and meaningful use is the starting point of our research (Burke et al., 2017).

Our study concerns the teaching of Informatics in primary school, a subject in which one might expect digital tools to be exploited with particular sophistication. The reality is more complicated. Even in Informatics, the interactive whiteboard is often reduced to a demonstration device, since the planning of genuinely interactive activities demands time, technical confidence, and a clear pedagogical rationale. We proceed from a straightforward premise. Technology becomes educationally significant only when it functions as a cognitive tool, that is, when it supports and extends the thinking of the learner rather than merely delivering content to a passive audience (Woodward, 2000).

This distinction — between technology as a tool of teaching and technology as a cognitive tool — lies at the heart of our work. It reframes the familiar debate. The issue is not whether the interactive whiteboard is present in the classroom, but how, and to what end, it is used. A device that dominates the front of the room can just as easily entrench transmission teaching as challenge it. Everything depends on the surrounding pedagogy.

More specifically, our research addresses three questions. a) In what ways is the interactive whiteboard pedagogically exploited in the teaching of Informatics in primary school? b) How does its use affect the engagement and participation of pupils in the learning process? c) What conditions — technical, pedagogical, and professional — are required for its meaningful exploitation as a cognitive tool rather than a means of projection? By examining the interplay between technological affordances and classroom activities, this study seeks to determine whether educators align their digital integration strategies with broader pedagogical frameworks or merely replicate traditional instruction (Aleksieva et al., 2025; Orellana et al., 2025).

The particular character of our study deserves emphasis from the outset. The researcher is at the same time the teacher of the class, and the design is one of action research (Laurillard, 2008; Muslu & Siegel, 2024). We therefore study our own practice, with the advantages and the risks that this entails. The following section concerns the theoretical framework that underpins our questions. We then describe the methodology of the action research, present the findings that emerged, and discuss their implications for teaching practice and for teacher education.

Theoretical Background

The integration of Information and Communication Technologies into education has been studied for several decades. Early expectations were often optimistic, assuming that access to technology would, by itself, improve teaching and learning. Research has since complicated this picture considerably. The mere presence of a device in the classroom does not guarantee a change in pedagogy, and technology may reinforce existing practice as readily as it transforms it (Larry, 2001). This sober recognition frames our theoretical position.

A more analytical framing distinguishes between two roles that technology can play in the classroom. In the first, the technology serves as a tool of teaching, supporting the transmission of content from teacher to learner. In the second, it operates as a cognitive tool — what Jonassen termed a mindtool — that engages learners in critical thinking and in the active construction of knowledge (Woodward, 2000). It is the second conception that we adopt. It shifts attention away from the delivery of information and towards the intellectual activity of the pupil.

The theoretical roots of this position lie in constructivism and in sociocultural theory. Constructivist accounts hold that learners actively build knowledge through experience and reflection, rather than receiving it ready-made (Fosnot, 1996). Vygotsky's sociocultural theory adds a crucial dimension. It locates learning within social interaction and mediated activity, and it treats tools as constitutive of thinking rather than incidental to it (Vygotsky, 1978). Tools, in this view, are never neutral. They mediate thought, and the interactive whiteboard can be understood as one such mediating artefact whenever it structures shared activity in the classroom. Papert's constructionism extends the argument further, since it holds that learning is most powerful when pupils build and manipulate external artefacts, testing their ideas in a visible medium (Papert, 1980). Within this paradigm, the interactive whiteboard functions not as a passive display for didactic presentation, but as a dynamic, shared space for collaborative problem-solving (Masoumi et al., 2023).

The framework of Technological Pedagogical Content Knowledge offers a complementary lens. It proposes that effective technology integration depends on the interaction of three forms of knowledge: technological, pedagogical, and content knowledge (Mishra & Koehler, 2006). An important implication follows directly. Competence with the device alone is insufficient. The teacher must combine technical fluency with pedagogical judgement and with a secure grasp of the subject, and it is the interaction of the three that determines the quality of the result. This perspective aligns with contemporary constructivist pedagogy, which advocates for technology to be utilized as a catalyst for high-level student competencies, including critical inquiry and collaborative problem-solving (Abedi, 2023; Abedi et al., 2023).

Concerning the interactive whiteboard specifically, the research literature is genuinely mixed. Reviews report increased motivation, sharper attention, a brisker pace of lessons, and the affordances of multimodal presentation and interactivity (Higgins et al., 2007). The board can display, annotate, drag, hide, and reveal, and it can combine text, image, and sound within a single shared space. Other studies are more cautious. They warn that the interactive whiteboard can entrench teacher-centred instruction, since the teacher typically controls the surface while the pupils remain spectators (Smith et al., 2005). The affordances of the device, in other words, are potential rather than guaranteed. Their realisation depends on how the teacher orchestrates classroom activity and on the extent to which pupils are given control of the board (Kennewell et al., 2007). Teaching style, as Beauchamp has shown, shapes the use of the technology at least as much as the technology shapes teaching (Beauchamp, 2004).

Furthermore, empirical evidence suggests that meaningful engagement increases significantly when teachers possess the technological pedagogical content knowledge to facilitate student-led interaction rather than relying on purely didactic demonstrations (Awuor & Okono, 2022; Baldonado & Cajandig, 2026). By repurposing non-educational software for unique instructional goals, educators can transform such tools into hubs where students negotiate meaning and construct knowledge collectively (Adipat et al., 2023). This integration of domain-specific expertise and pedagogical competence is essential, as teachers who lack a deep mastery of their subject matter frequently encounter significant obstacles when attempting to merge digital tools into the learning process (Valle et al., 2024). Consequently, the TPACK framework serves as an invaluable guide for instructors to critically assess the affordances and limitations of their digital resources, ensuring they remain focused on transformative pedagogical goals rather than mere tool implementation (Nepembe & Simuja, 2023). Ultimately, the successful adoption of these technologies hinges upon a sustained commitment to professional development that allows educators to adapt their strategies to evolving instructional needs.

METHODOLOGY

Research design and participants

The following section concerns the design of our research. Our study adopts a qualitative case study approach with the characteristics of action research. The choice is deliberate rather than incidental. Action research is well suited to the systematic investigation of one's own practice, since it proceeds through iterative cycles of planning, action, observation, and reflection (Kemmis & McTaggart, 1982). In our case the researcher holds a dual role. The same person plans and delivers the teaching intervention with the interactive whiteboard and, at the same time, studies it. This arrangement permits the examination of teaching practice from within — an advantage that, as we discuss below, carries its own risks.

The setting was a single class of a primary school during the teaching of Informatics. The participants were sixteen pupils of the fourth grade, an age at which children can already work with visual and spatial representations yet still benefit from concrete, hands-on manipulation. The teaching unit concerned mind maps. The topic lends itself naturally to an interactive treatment, since a mind map is by its very nature a structure that is built, rearranged, and revised rather than simply read (Gao et al., 2024). This made it a fitting vehicle for our purpose. The interactive whiteboard was therefore employed not as a projection surface but as a shared workspace for manipulation, categorisation, and problem-solving, on which the map could take shape in front of the whole class.

Two software environments supported the intervention. Each one was used in a separate lesson. The first was MindMeister, an online collaborative mind-mapping application (https://www.mindmeister.com/), which allowed pupils to create nodes, connect ideas, and reorganize a map directly on the board (Hartikainen et al., 2019). The second was a Scratch project that we designed specifically for this lesson, in order to present the underlying logic of a mind map — the grouping of related ideas around a central concept — as an interactive activity that pupils could run, test, and modify (Zitouniatis et al., 2022). The choice of two complementary tools was deliberate. MindMeister offered an authentic, purpose-built environment for the construction of maps, while the tailored Scratch project allowed us to isolate and dramatize the conceptual core of the lesson in a form the children could manipulate. More analytically, the activities were designed so that pupils would physically interact with the board — moving objects, matching concepts, ordering the steps of a procedure, and testing hypotheses — rather than watching the teacher operate it. Each lesson was planned, taught, and then reviewed, and the insights of one cycle informed the design of the next. This iterative approach mirrors established practices in design-based research, where classroom interventions are refined through constant feedback loops to optimize student meaning-making processes (Beal & Steier, 2024).

Data collection

Since the researcher is simultaneously the teacher of the class, the semi-structured interview with the teacher that a conventional design would include has no place in our study. One cannot interview oneself. We therefore replaced it with instruments appropriate to the reflective practitioner, whose knowledge is generated in and through action (Schön, 1983). The following instruments were used for the collection of data:

- A reflective journal maintained by the teacher-researcher, in which observations, difficulties, decisions, and thoughts concerning the exploitation of the interactive whiteboard were recorded after each lesson; it constitutes the principal source of the teacher's perspective (Latifa et al., 2025).
- Field notes kept during, or immediately after, each lesson, with particular emphasis on critical incidents, pupil reactions, and observable moments of engagement or disengagement (Godec et al., 2018).
- A short questionnaire, supplemented by a group discussion, addressed to the pupils, in order to preserve the learners' perspective and to serve as an element of triangulation.
- Samples of pupils' work, gathered as tangible evidence of the learning process and of the transfer from board activity to independent task.

Data analysis and rigour

The analysis of the data was carried out through thematic analysis, a flexible method for identifying, analysing, and reporting patterns of meaning within qualitative material (Braun & Clarke, 2006). We familiarised ourselves with the material through repeated reading, generated initial codes across the whole dataset, and then grouped these codes into candidate themes concerning engagement, the role of the device, and the conditions of its exploitation. The themes were reviewed against the data and refined before the writing of the analysis.

Triangulation is central to our design. By combining the reflective journal, the field notes, and the data drawn from pupils, we sought to strengthen the credibility of the findings and to limit the subjectivity that the dual role inevitably introduces. An important qualification belongs here (Ahumada-Newhart & Warschauer, 2016). The teacher-researcher is not a neutral observer, and the risk of bias is real rather than hypothetical. We addressed it explicitly, through triangulation and through sustained reflexivity, acknowledging throughout that our interpretations are situated rather than detached. Finally, ethical considerations were observed across the whole procedure. Informed consent was secured from the parents of the pupils, participation was voluntary, and the anonymity of the children was preserved at every stage (Cohen et al., 2017).

FINDINGS

The following section presents our findings, organized around three themes that emerged from the analysis. We report them with the caution that a single case demands.

Engagement and participation

The first theme concerns engagement and participation. Across the reflective journal and the field notes, a consistent pattern emerged. When pupils were invited to come to the board and manipulate objects themselves, their attention and involvement rose noticeably. The difference is telling. In lessons where the interactive whiteboard functioned as a screen, participation resembled that of an ordinary lesson, with a handful of pupils answering and the rest looking on. In lessons designed around pupil interaction, by contrast, more children volunteered, hands rose more readily, and the classroom conversation became distinctly more animated. The pupils' own responses confirmed the impression. In the questionnaire and in the group discussion they expressed a clear preference for lessons in which they could touch and move things on the board, describing these as more interesting than simply watching. This much was expected. What followed was less so.

From engagement to cognition

The second theme concerns the conditions under which the device operates as a cognitive tool. Here the evidence is more nuanced, and more interesting. Our journal entries reveal that engagement alone did not guarantee deeper thinking. Some interactive activities generated evident enthusiasm but little cognitive demand, since the pupils enjoyed the novelty of the touch surface without engaging seriously with the underlying concept. The more productive lessons were those in which the interactivity was tied to a genuine cognitive task — classifying items according to a rule they had to infer, predicting the outcome of a short procedure before running it, or locating and correcting a deliberate error placed on the board. This is perhaps the most important finding of our study. The interactive whiteboard supported thinking not through its technical novelty but through the design of the activity that framed its use.

The samples of pupils' work reinforce this interpretation. Where the board activity was well aligned with a conceptual goal, the subsequent written or practical work showed clearer understanding and fewer misconceptions. Where the activity was merely interactive, the transfer to independent work was noticeably weaker. More specifically, we observed that tasks requiring pupils to justify a choice at the board — to explain aloud why an item belonged in a particular category — produced the most robust learning, since the justification made the reasoning visible to the whole class. An important distinction. Doing something on the board is not the same as thinking through it.

Tensions and conditions of exploitation

The third theme concerns the tensions and the conditions of exploitation. Several difficulties recur throughout the reflective journal. Technical problems, such as calibration drift and software delays, occasionally disrupted the flow of a lesson and consumed valuable instructional time. Managing turn-taking at the board proved demanding, since only one or two pupils can interact with the surface at any moment while the remainder observe and, sometimes, disengage. And the design of genuinely interactive activities required considerable preparation time, well beyond that of a conventional lesson. An honest admission belongs here. On more than one occasion the pressure of the timetable pushed us back towards the easier option of projection, precisely the practice our study set out to question.

Taken together, these three themes suggest a coherent picture. The interactive whiteboard has a real capacity to enrich the teaching of Informatics in primary school, yet this capacity is realized only under specific conditions. Engagement is relatively easy to achieve. Cognitive depth is not. The device rewards deliberate pedagogical planning, and it quietly penalizes its absence, since without such planning the impressive surface reverts to being an expensive screen.

DISCUSSION

The following section discusses our findings in relation to the theoretical framework and the existing literature. Our results align closely with the more cautious strand of research on interactive whiteboards. They confirm that the device can raise motivation and participation, as reviews have consistently reported (Higgins et al., 2007). But they also support the warning that interactivity at the surface does not translate automatically into interactivity of thought (Smith et al., 2005). The distinction between the device as a tool of teaching and as a cognitive tool proved analytically useful from the first lesson to the last.

More analytically, our findings give concrete form to the theoretical claim that tools mediate learning only within structured activity (Vygotsky, 1978). The interactive whiteboard did not teach. The activities designed around it did, and their cognitive quality determined the outcome. This is entirely consistent with the framework of Technological Pedagogical Content Knowledge, since the productive lessons were precisely those in which technological, pedagogical, and content knowledge were brought together (Mishra & Koehler, 2006). Competence with the device was necessary. It was never, on its own, sufficient.

There is a further point worth making, and it concerns the conditions of teaching. The tensions we recorded — time, turn-taking, technical reliability — are not incidental irritations. They shape what is pedagogically possible, and they help to explain why teachers so often retreat to the safety of projection. Any serious effort to exploit interactive whiteboards as cognitive tools must therefore attend to the conditions of teachers' work, and not merely to the improvement of their technical skills. This is a matter of policy as much as of pedagogy (Burke et al., 2017).

We hold these conclusions tentatively, as the design requires. A single case, examined by a teacher who is also the researcher, cannot support broad generalization, and our position inside the classroom shaped what we were able to see. The findings should therefore be read as illuminating rather than definitive. Their value lies in the depth of a particular case, not in the breadth of a sample. That, we would argue, is exactly what a case study is for.

CONCLUSION

Our study set out to examine the pedagogical exploitation of the interactive whiteboard in the teaching of Informatics in primary school. The picture that emerges is neither dismissive nor celebratory. The interactive whiteboard is not inherently transformative, and it is not inherently trivial. Its educational value is constituted in the pedagogical decisions that surround it.

Three conclusions follow from our work. First, the device supports engagement most reliably when the pupils, and not only the teacher, manipulate its surface. Second, engagement becomes learning only when the interactivity is tied to a genuine cognitive task that demands reasoning rather than mere activity. Third, the exploitation of the device as a cognitive tool depends on conditions — preparation time, technical reliability, and thoughtful pedagogical design — that lie beyond the technology itself.

These conclusions carry clear implications for practice. They suggest that teacher education should focus less on the operation of the device and more on the design of activities that turn interaction into thinking. Furthermore, they point to the importance of supporting teachers with time and resources, since the retreat to projection is often a rational response to genuine practical pressure rather than a failure of will.

Future research could extend our approach to other subjects and to larger and more varied samples, and could examine, over longer periods, how the sustained use of the interactive whiteboard shapes pupils' learning and thinking. For the present, our modest case offers a reminder that is surprisingly easy to forget. The tool does not teach. The teaching does, and the interactive whiteboard is worth its place in the primary classroom only to the degree that it is made to serve the thinking of the child.

Ethical Considerations

This research was conducted in accordance with recognised ethical standards for educational research.

Conflict Of Interest

The author declares no conflict of interest.

Data Availability

The qualitative data generated during this study may be made available from the author upon reasonable request.

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