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ADAPTIVE ICT STRATEGY UNDER KAPAS GULA MODULE 125 USING SCRATCH AND AN INTERACTIVE DIGITAL PANEL TO STRENGTHEN STUDENTS' NUMERACY LITERACY: A BEST PRACTICE IN GRADE IX INFORMATICS LEARNING AT SMP NEGERI 1 KENDAL

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ABSTRACT

SMP Negeri 1 Kendal (State Junior Secondary School 1, Kendal), Indonesia, recorded a decline in higher-order numeracy reasoning (Level 3/L3) on the 2024 Education Report Card. This weakness was mirrored in Grade IX Informatics classes, where Algorithm and Programming instruction remained abstract, teacher-centered, and text-based, leaving most observed students passive and the majority of surveyed students (n = 32) reporting the material as unengaging. This paper reports a single-class best-practice intervention integrating the Scratch block-based programming environment with the school's existing Interactive Digital Panel (PID), operationalizing Unit IV (Adaptive Implementation Strategy) of KAPAS GULA Module 125. Over four weekly sessions in January 2026, 32 Grade IX A students used touch-screen, drag-and-drop manipulation of Scratch blocks to construct number-base conversion programs and function-based modules through a Project-Based Learning approach. Process-level results showed that all students completed a manual number-conversion task, over 85% built an error-free Scratch conversion program, and group presentations reached 'Competent' to 'Proficient' levels; the teacher's own Innovative Practice indicator on the Education Report Card rose from 62.65 to 76.87. Concurrent gains in broader, school-wide Report Card indicators were also documented, but as aggregate whole-school figures they cannot be causally attributed to this single four-week unit. Remaining challenges included weak performance on abstract topics such as probability and exponents, and low independent-learning habits. Findings support Scratch-PID integration as a low-cost, replicable strategy for engaging students in computational and numeracy reasoning, pending confirmation through a controlled, class-level evaluation design.

KEYWORDS: Scratch; interactive digital panel; numeracy literacy; adaptive learning; computational thinking.

INTRODUCTION

Twenty-first-century education demands a shift toward Higher Order Thinking Skills (HOTS). Under Indonesia's Kurikulum Merdeka, strengthening numeracy literacy and school digitalization are stated national priorities. Numeracy literacy is understood not merely as basic arithmetic but as the capacity to reason logically using mathematical concepts, procedures, and computational tools to solve real-world quantitative problems.

At SMP Negeri 1 Kendal, the 2024 Education Report Card showed the Numeracy Ability indicator (A.2) at a 'Good' level (63.95), with 81.82% of students meeting minimum competency. However, sub-indicator analysis revealed a decline in higher-order reasoning: the proportion of students 'above minimum competency' fell 3.49 percentage points (46.67% in 2023 to 43.18% in 2024), the Reasoning Competency/Level 3 (L3) sub-indicator (A.2.7) declined from 62.50 to 62.13, and the Data and Uncertainty domain (A.2.4) declined from 64.99 to 63.05. In Grade IX Informatics lessons on Algorithms and Programming, this manifested as three concrete classroom problems: students struggled to operate numeric variables and arithmetic expressions (computational thinking); students could not translate mathematical logic into conditional and looping structures; and students had difficulty analyzing the causal relationship between changes in input variables and program output.

Root-cause analysis, triangulating classroom observation, in-depth interviews, and a pre-intervention questionnaire (n = 32 Grade IX A students), identified three interrelated causes: (1) conventional, teacher-centered instruction relying on syntax memorization from static text, inconsistent with constructivist accounts (Piaget; Vygotsky) holding that abstract concepts such as computational logic are best constructed through direct, hands-on manipulation of concrete or digital objects; (2) the absence of interactive, manipulable learning media, consistent with Resnick et al.'s (2009) argument that novice programming instruction requires a block-based environment supporting 'tinkering' — trying, detecting errors, and self-correcting; and (3) underused smart-classroom infrastructure, since the school's touch-screen Interactive Digital Panel (PID) had previously functioned only as a static projector, with 0% recorded student touch-screen interaction, despite evidence that interactive whiteboards raise numeracy reasoning only when used as a collaborative medium involving dynamic physical and visual student interaction (Higgins, Beauchamp, & Miller, 2007).

To address these causes, the teacher implemented competencies from KAPAS GULA Module 125: Adaptive and AI-Integrated Use of ICT in Learning, specifically Unit IV (Adaptive Implementation Strategy), integrating the Scratch visual programming environment with the PID. This paper aims to: (1) describe the operational implementation of this Scratch-PID strategy in Grade IX Informatics learning; (2) examine how this integration visualizes abstract Algorithm and Programming concepts to strengthen student numeracy reasoning; and (3) evaluate how the strategy optimized use of existing smart-classroom assets to support active student engagement and collaboration.

MATERIALS AND METHODS

This paper reports a single-class, teacher-authored best-practice intervention rather than a controlled experiment; it draws on a participatory-action-research orientation in which the teacher acted as both practitioner and reflective evaluator. Three alternative solutions were considered before the strategy was selected: (1) text-based programming (Python/C++) with structured worksheets, rejected due to high syntax-error cognitive load that would divert attention from numeric reasoning; (2) unplugged computational-thinking activities (logic cards, board games, role-play), rejected because they provide no real-time feedback on complex numeric-variable execution and would not use the school's existing digital assets; and (3) Scratch block-based coding operated on the PID touch-screen, selected because it eliminates syntax-error risk, converts individual coding at a small monitor into large-scale, touch-based collaborative exploration, and requires no new budget, using only existing school infrastructure and open-source software.

The intervention involved 32 Grade IX A students, purposively selected because 2024 Education Report Card diagnostic data identified this class as having the weakest baseline L3 reasoning and theoretical coding comprehension among Grade IX classes. Sessions were held every Wednesday (7, 14, 21, and 28 January 2026) in the school's computer laboratory/smart classroom. Roles were divided among the principal (supervisory approval of the teaching module and ICT-facility oversight), the Informatics teacher (designing differentiated modules, facilitating Scratch coding guidance, preparing worksheets, and conducting formative and summative assessment), students (completing manual conversion tasks and constructing Scratch code individually, in pairs, and in small groups), and ICT support staff (maintaining computer units, network stability, and Scratch software installation).

The four-week implementation followed a structured sequence: Week 1 covered binary and octal number-base concepts and manual conversion algorithms; Week 2 introduced basic Scratch visual programming, with students constructing variables and looping algorithms for automatic decimal-to-binary conversion; Week 3 provided scaffolded intervention for students struggling with coding logic and reinforced debugging skills; and Week 4 focused on program modularization linked to quadratic-function concepts, culminating in small-group projects and presentations.

Monitoring combined weekly process checks (a daily teaching journal and a student performance-observation sheet) with peer-mentoring observation during the Week 4 group session, and outcome evaluation combining quantitative task-completion rates with qualitative rubric-based assessment of group presentations (Achievement Criteria/KKTP levels: Competent to Proficient). Supporting documentation included the teaching journal, assessment instruments and rubrics, a weekly progress log, code screenshots, and attendance records. Data were analyzed descriptively, comparing pre- and post-intervention observations and task-completion rates; no inferential statistical testing or comparison class was used, and the design does not permit isolating the effect of the Scratch-PID strategy from other concurrent factors.

RESULTS AND DISCUSSION

Results

Weekly Implementation Progress

Table 1 summarizes the four-week implementation and the physical evidence collected at each stage.

Date	Topic	Output / Physical Evidence
Wed, 7 Jan 2026	Binary and octal numbers (manual conversion)	Worksheet results: decimal-to-binary/octal conversion
Wed, 14 Jan 2026	Scratch programming module (numeric literacy)	Scratch project file: decimal-to-binary conversion
Wed, 21 Jan 2026	Scratch programming module (debugging)	Debugged Scratch project files
Wed, 28 Jan 2026	Program modularization (quadratic function)	Group presentation slides/documents; quadratic-function module

Source: teacher's daily teaching journal and classroom observation sheet, January 2026.

Task-completion data indicate that 100% of Grade IX A students completed the manual number-conversion task (7 January), and more than 85% successfully built a working, error-free Scratch conversion module during the second and third weeks (14-21 January). Qualitatively, group presentations in the final week reached 'Competent' to 'Proficient' levels on the school's Achievement Criteria (KKTP) rubric, and 100% of small groups presented a functioning modularized program linked to quadratic-function concepts.

Teacher-Level and School-Wide Indicators

At the teacher level, the Innovative Practice Application indicator (D.2.3) on the Education Report Card rose from 62.65 to 76.87 following the reflective trial of this new method, and prior documentation had already shown the Reflection on Teaching Practice indicator (D.2.2) at 76.57, supporting the teacher's readiness to implement technology-based modules. The original internal report also cites concurrent improvements in several school-wide Education Report Card indicators over the same period — including Learning Quality (D.1) reaching 70.83, Literacy proficiency rising to 95.56%, Numeracy proficiency reaching 82.22%, Active Student Engagement (E.1.2) reaching 88.85, and the Character Index (A.3) rising to 71.38 — alongside subject-specific national-assessment sub-scores in Indonesian Language and Mathematics. These are aggregate, whole-school figures drawn from the same annual Education Report Card and national assessment cycle, not measurements specific to the 32-student, four-week Scratch-PID unit reported here; they are noted as contextual, concurrent developments rather than as outcomes demonstrated to result from this intervention (see Study Limitations).

DISCUSSION

Interpretation of Classroom-Level Findings

The classroom-level completion and debugging rates are consistent with Resnick et al.'s (2009) account of block-based 'tinkering': removing syntax-error risk through drag-and-drop blocks allowed students to focus cognitive effort on variable logic and arithmetic operations rather than on syntax memorization. The shift from 0% recorded student touch-screen interaction to active, hands-on manipulation of Scratch blocks on the PID is consistent with Higgins et al.'s (2007) finding that interactive whiteboards influence numeric reasoning only when used as a collaborative, physically interactive medium rather than a static display.

Lessons Learned

Reflective practice and willingness to trial the new method contributed to the teacher's own Innovative Practice Application gain noted above. A positive-discipline, structured classroom-management approach supported an orderly learning space. However, several challenges persisted: performance remained weak on more abstract topics such as complex probability (33.68%) and exponents/roots (29.53%); students had difficulty evaluating the coherence between visual illustrations and text content in related literacy tasks (55.69%); and an independent-study-habit indicator remained low, suggesting continued dependence on direct teacher guidance. In response, the teacher applied real-time adaptive scaffolding — simplifying task difficulty and shifting from lecture to structured group discussion when students reached a reasoning impasse, and differentiating support by providing concrete aids for struggling groups and extension challenges for faster learners.

Follow-Up Plan

To sustain the practice, four follow-up actions were identified: systematizing a Scratch-PID adaptive practicum module as a standing student-centered worksheet set; developing a wider repository of interactive Scratch logic activities for continued independent and paired practice; establishing a rotating smart-classroom usage and maintenance schedule coordinated with school IT staff; and disseminating the practice through the school's Teacher Learning Community and the district Informatics subject-teacher forum (MGMP Sub-Rayon 01 Kendal).

Study Limitations

Several limitations should be stated explicitly. First, this is a single-class, single-teacher, four-week best-practice account without a comparison class or control group; task-completion rates and rubric levels cannot be isolated from concurrent maturation, other concurrent programs, or general classroom-management effects. Second, the sample is small (n = 32) and specific to one purposively selected class, limiting generalizability. Third, and most importantly, several quantitative figures presented in the original internal report as apparent outcomes of this intervention — school-wide Learning Quality, Literacy, Numeracy, Character, and psychological-wellbeing indicators, and subject-specific national-assessment sub-scores — are aggregate, whole-school Education Report Card and national-assessment figures that reflect the entire student population across all subjects, not the 32 students or the specific four-week unit described here; attributing these school-wide figures causally to a single Informatics unit is not supported by the study design and has been reframed in this manuscript as concurrent contextual information rather than as demonstrated impact. Fourth, no independent verification instrument was used for the completion-rate and rubric data, which rely on the teacher's own daily journal and observation sheet. Future evaluation of this strategy would benefit from a class-level pre-post computational-thinking and numeracy instrument, a comparison class, and independent scoring of student artifacts.

CONCLUSION

Integrating the Scratch block-based programming environment with the school's existing Interactive Digital Panel, as an application of KAPAS GULA Module 125 Unit IV (Adaptive Implementation Strategy), shifted Grade IX A Informatics instruction on Algorithms and Programming from abstract and teacher-centered toward active, exploratory, and student-centered learning. Within the four-week unit, all students completed a manual number-conversion task, more than 85% built a working Scratch conversion program, and group presentations reached competent-to-proficient levels, while the teacher's own innovative-practice indicator on the Education Report Card improved. These classroom-level results support Scratch-PID integration as a practical, low-cost, and replicable strategy for engaging students in computational and numeracy reasoning using existing school infrastructure. However, because the design is a single-class descriptive account without a control group, and because several broader indicators cited in the original report are school-wide rather than class-specific measurements, claims of impact on numeracy literacy beyond the classroom level should be treated as preliminary and contextual rather than as confirmed causal outcomes. For Informatics teachers, the practice suggests developing project-based, drag-and-drop worksheets matched to touch-screen panel features and applying adaptive, on-the-spot scaffolding; for school principals, it suggests formalizing a rotating schedule for shared smart-classroom assets and facilitating regular sharing sessions; for the district education authority, it suggests considering this Scratch-PID integration as a replicable model for asset-based numeracy strengthening, supported by future studies using a class-level comparison design and standardized outcome instruments.

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