



Management of Physics Teaching Activities in Upper Secondary Schools in The Central Highlands in The Context of Digital Transformation

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ABSTRACT

This mixed-methods study investigates the status of Physics teaching and its management in Central Highlands upper secondary schools under the 2018 General Education Curriculum (GEC 2018) and digital transformation. Drawing on 834 valid questionnaires, interviews, and document review, the findings reveal that management performance is constrained by limited use of digital tools and is weakest in data-informed monitoring, feedback, and adaptive adjustment—indicating a major gap in evidence-based digital governance. Accordingly, the study proposes three interventions aligned with the “capacity–process–data” logic; an experiment with Intervention 2 yields clear positive effects, confirming it as the operational core for establishing a data feedback loop, strengthening accountability, and sustaining improvements in the quality of Physics teaching tailored to regional conditions.

KEYWORDS: Physics teaching management, education digital transformation, data-driven management, digital evidence-based decision-making, 2018 General Education Curriculum.

1. INTRODUCTION

In the context of national digital transformation and the breakthrough development of Education and Training under Resolution 71-NQ/TW (August 22, 2025), teaching management needs to shift from an administrative command model to flexible governance based on technology, data, personalized experimental learning, and the requirement to develop natural science competencies according to the 2018 GEC. The quality of Physics teaching depends simultaneously on teacher activities such as (i) organizing teaching activities, (ii) managing learning activities, and (iii) creating a supportive learning environment (physical – mental – digital technology) to ensure interaction and support.

However, surveys on the status of teaching and management of Physics in Central Highlands upper secondary schools reveal that while digital transformation (DX) policies are in place and supported by teachers and managers, there is a lack of synchronous operational mechanisms within the digital ecosystem. Furthermore, data-driven management remains limited, and decision-making based on digital evidence is not yet clearly defined. Therefore, this study focuses on analyzing the current state of Physics teaching activities to clarify the causes of these limitations, thereby proposing a group of management

interventions to enhance quality in a sustainable manner that is appropriate for the region's specific characteristics. Within the scope of this paper, the research focuses on the current situation and proposes management measures for Physics teaching activities in the context of implementing the 2018 GEC and digital transformation.

2. THEORETICAL FRAMEWORK

Teaching management in secondary schools is a system of purposeful actions by managers to plan, organize, direct, and check/assess the teaching process to achieve educational goals. In the context of the 2018 GEC and digital transformation, the management of Physics teaching is understood as the process by which Principals/Vice Principals and Subject Heads operate teaching according to data and digital evidence. This ensures that students meet the required standards and develop Physics competencies, including: Physics cognition, exploring the natural world from a Physics perspective, and applying knowledge and skills.

2.1 Management of planning physics teaching activities (data-driven)

Physics teaching plans must be designed based on input data and several criteria: (i) legal documents, the curriculum, and testing-assessment regulations; (ii) local

context and learner needs (STEM orientation, equipment/bandwidth conditions); (iii) school resources (teaching staff, specialized rooms, experimental equipment, digital infrastructure); and (iv) quality data from previous years (results by topic, conceptual errors, lab completion rates). Plans must be standardized according to a structure where goals are linked to required achievements and the three components of Physics competence. This extends from content/topics to experimental activities/simulations, data processing, digital learning materials, and assessment according to competency matrices and rubrics.

2.2. Management of organizing and directing physics teaching in a digital environment

Implementation focuses on assigning tasks based on teacher capacity (e.g., strong in experiments vs. strong in digital technology) and ensuring material and financial conditions for key activities (simulations, digital devices, teacher training). Professional direction must follow the scientific progression of Physics: posing a problem → experimentation/simulation → data collection and processing → explanation → application. This ensures students actually operate measurement tools and reasoning rather than ICT being used merely for presentations. Managers must maintain a feedback mechanism to adjust plans based on digital evidence (LMS/SMAS logs, lab report quality).

2.3. Management of assessment and digital records to form an improvement loop (PDCA)

Assessment management shifts from "grading" to "competency assessment" using digital tools (rubrics, measurement data, project products, anti-cheating logs), creating reliable data for management decisions. The core digital evidence includes: (i) digitized subject teaching plans; (ii) competency matrices and evidence of experimental activities; (iii) digital dashboards displaying quality data; (iv) digitized lesson observation records; and (v) digital material repositories and student electronic portfolios.

3. RESEARCH METHODOLOGY

The study utilized a mixed-methods approach, combining quantitative and qualitative research. In this design, the quantitative method (conducted via questionnaires) served as the primary approach to describe and quantify the current status of Physics teaching and its management. The qualitative method (expert interviews/exchanges and document analysis) was employed to clarify the underlying causes and provide an in-depth interpretation of the identified "bottlenecks".

Quantitative survey: The survey was administered using questionnaires to three target groups: school managers,

Physics teachers, and students at upper secondary schools in the Central Highlands. A stratified random sampling technique was selected based on regional distribution (urban centers, suburban areas, and remote areas) across the Central Highlands. The minimum sample size was determined using the Slovin formula, resulting in 431 valid responses (comprising 201 school managers and 230 teachers).

Research instruments: The survey tools consisted of two questionnaires (one for teachers and one for managers). These instruments included three primary scales: (i) the status of Physics teaching activities; (ii) the status of teaching management; and (iii) the feasibility and effectiveness of the proposed interventions. These scales were developed based on a review of previous research regarding teaching management and digital transformation in education, adjusted to suit the specific conditions of upper secondary schools in the Central Highlands. Variables were measured using a 5-point Likert scale, with levels categorized by a scale interval of 0.80 (ranging from "Poor" to "Good").

Data processing: Data analysis involved descriptive statistics and a synthesis of quantitative and qualitative findings. The data were processed to describe the current situation and identify consistent "bottlenecks". The reliability of the scales was verified using the Cronbach's Alpha coefficient ($\alpha=0.70$). Statistical analysis was performed using SPSS software, employing descriptive statistics (Mean, Standard Deviation, Skewness, Kurtosis) and t-tests for the pre-and post-experiment design. Additionally, semi-structured interviews were conducted with school managers and teachers to clarify the causes of bottlenecks in digital evidence-based management. Qualitative data were thematically coded and utilized for triangulation to support the quantitative results.

Research setting: The study was conducted at upper secondary schools in the Central Highlands, with participating schools representing central wards/communes and suburban areas.

4. RESULTS AND DISCUSSION

4.1. Status of Physics teaching activities

The survey results (Table 1) show that while teachers possess a solid pedagogical foundation (GEC 2018 goals Mean = 4.17; Assessment Mean = 4.39), the use of digital tools is the lowest criterion (Mean = 3.45). This identifies a clear "bottleneck": teachers are ready for pedagogical innovation, but their digital capacity and access to tools lag behind, hindering the transformation of ideas into classroom practice in a digital context.

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Table 1. Evaluation Results of Teachers' Physics Teaching Activities (F_HDD)

No.	Criteria Content	Mean	SD	Rank	Level
1	Competency goals of the lesson/topic according to GEC 2018.	4.17	0.898	2	Good
2	Content based on required achievements, active teaching methods (experiment, simulation, PBL, debate...) used in Physics teaching.	3.89	0.788	3	Good
3	Digital tools (AI, LMS, question banks, PhET simulations, clicker...) used in Physics teaching.	3.45	0.898	4	Average
4	Formative assessment using rubric/learning portfolio/product, K12 software...	4.39	0.799	1	Excellent
	Overall Average	3.98	0.854		Good

4.2. Status of Physics teaching management

Management is strong in "orientation" (Planning Mean = 4.41; Training Mean = 4.40) but weak in "quality operation." Specifically, monitoring and adjusting plans based on data is the weakest area (Mean = 3.08), indicating a

core gap in digital evidence-based feedback mechanisms. The survey results in Table 2 indicate that the management of Physics teaching activities in upper secondary schools reached a "Good" level (Overall Mean = 3.81; SD = 0.912).

Table 2. Evaluation of Physics teaching management

No.	Content	Mean	SD	Rank	Level
1	Teaching plans according to GEC 2018: clear goals/content/methods.	4.41	0.970	1	Excellent
2	Organizing teaching; directing teachers to use active methods (PBL, virtual labs, simulation, AI...) and competency-based assessment.	3.30	0.881	3	Average
3	Monitoring and supporting plan adjustments based on data (scores, feedback).	3.08	0.830	4	Average
4	Organizing training for teachers on digital capacity and interactive pedagogy.	4.40	0.970	2	Excellent
	Overall Average	3.81	0.912		Good

Notably, two stages belonging to the "orientation layer" of management stood out: planning and staff professional development. Specifically, the criterion for teaching plans according to the 2018 General Education Curriculum (GEC) was rated highly (TC1: Mean = 4.41), reflecting that schools have relatively clearly established goals, content, and methods, ensuring program implementation requirements. Simultaneously, professional development for teachers regarding digital capacity and interactive pedagogy also reached a high level (TC4: Mean = 4.40), showing an investment in innovation capacity and adaptation to the digital transformation context. However, two criteria belonging to the "quality operation layer" only reached an "Average" level: organizing and directing innovative teaching methods/competency-based assessment (TC2: Mean = 3.30), and especially monitoring and supporting plan adjustments based on data, which was the lowest (TC3: Mean = 3.08). These results imply that the management system is strong in "written planning" and "training" but remains weak in transforming orientations into stable and consistent classroom teaching practices.

Comparison with the theoretical framework of teaching management—encompassing planning, organizing, directing, and monitoring/assessing within a digital environment—reveals a core gap in the mechanisms for monitoring, feedback, and adjustment based on data and digital evidence (a "post-planning" fracture). Specifically, schools have not yet fully established a "data pipeline" for

Physics teaching governance (including LMS logs, digital learning products/e-portfolios, rubric data, competency-based assessment, and digitized classroom observation data). Furthermore, responsibilities among Vice Principals, Subject Heads, and teachers regarding data collection, standardization, analysis, and feedback have not been clearly defined. Consequently, evidence is not synthesized into periodic reports or dashboards, leading to adjustment decisions based primarily on experience, which diminishes the effectiveness of the continuous improvement loop (PDCA). Based on this, priority should be given to "leverage" interventions, such as: standardizing professional learning communities/lesson studies based on data and digital evidence, and establishing minimum standards for governance tools (including Physics lesson observation rubrics integrated with experiments, data, graphs, errors, and applications; digital observation forms; and theme-and-competency-based dashboard mechanisms). These measures will ensure that direction and assessment shift from "documentation-based" to "evidence-based," thereby increasing the consistency of pedagogical innovation and enhancing the quality of Physics teaching.

4.3. Proposed Interventions

Intervention 1: Capacity building for school managers and Physics teachers regarding digital transformation and innovative governance mindsets

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Objective: To unify awareness and enhance governance, professional, and digital capacities for organizing teaching according to the 2018 General Education Curriculum (GEC). This involves shifting from experience-based management to data/evidence-driven governance to develop the three core components of students' Physics competence.

Key Content:

(1) Proper perception of digital transformation (DX): Recognizing that DX is not merely "digitizing presentations" but involves restructuring management processes—planning, organizing, monitoring, assessing, and improving—based on technology and data.

(2) Digital teaching governance capacity for managers: Focusing on managing subject plans, teaching processes, competency-based assessments, and learning data, as well as monitoring implementation via Learning Management Systems (LMS) and digital material repositories.

(3) Digital teaching capacity for Physics teachers: Designing lesson plans based on competency logic; organizing real/virtual experiments and simulations; implementing flipped classrooms; utilizing differentiated assignments; and conducting regular assessments via rubrics with timely feedback.

Intervention 2: Directing Physics departments to develop and adjust teaching plans based on data; innovating Professional Learning Communities (PLCs) toward Lesson Study integrated with Digital Transformation

Objective: To standardize Physics teaching plans integrated with digital transformation and establish a regular operational mechanism of "planning – implementation – data collection and analysis – plan adjustment and evidence-based decision-making".

Implementation Strategy:

(1) Data-driven diagnosis: Analyzing learning outcomes by topic, errors identified by Physics competency indicators, and LMS learning logs or electronic records to identify "bottlenecks".

(2) Standardizing digitized Lesson Plan (LP) frameworks and digital evidence matrices: Ensuring each lesson or topic includes data-generating tasks (experiments, simulations, or data processing), digital products, rubrics, and pre- and post-activity evidence.

(3) Organizing PLCs through Lesson Study within the department's digital ecosystem: Utilizing the LMS, professional forums, digital material repositories, experimental datasets, electronic records, and dashboards to track progress and quality

Intervention 3: Innovating the management of Physics assessment based on digital platforms (K12/LMS), rubrics, and learning data analysis

Objective: To ensure that competency-based assessment is objective, timely, and transparent; and to generate operational data for the Principal and the professional department.

Implementation Strategy:

(1) Standardizing the assessment framework according to the three components of Physics competence and the evidence system.

Digitizing assessment tools: developing question banks with metadata tags (tags) by topic, difficulty level, and targeted competence.

(2) Organizing assessments on Learning Management Systems (K12_online).

Implementing rubrics for experiments, simulations, and STEM/project-based learning.

Maintaining digital learning tracks within management software.

(3) Analyzing assessment data for governance decision-making: identifying difficult topics, typical misconceptions, and progress over time.

Adjusting teaching plans and teacher professional development based on identified "data bottlenecks".

4.4. Testing of Interventions

Intervention 2 (BP2) was tested over 4 weeks using a pre-test and post-test design on two groups: Physics Teachers (N=59) and School Managers (N=48). The results showed a statistically significant change ($p < 0.05$).

Analysis of Table 3 shows that: For the teacher group, the mean scores increased synchronously with a difference (Δ) ranging from +1.3574 to +1.4016. The consistent upward trend in variables related to professional learning communities (PLC)/lesson study, monitoring, and system updates indicates that Intervention 2 (BP2) directly impacted the "operational phase" of data-driven management.

Table 3. Results of testing BP2 on teacher and manager groups

No.	Management Content	Code	Teacher Group Mean (Pre)	Teacher Group Mean (Post)	Difference (Δ)	Manager Group Mean (Pre)	Manager Group Mean (Post)	Difference (Δ)
1	Planning for DX management in	F_LKH	2.2504	3.6493	+1.3989	2.2542	3.3974	+1.1432

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	competency-based Physics teaching.							
2	Innovating Physics teaching methods with DX as a driver.	F_PPDH	2.4803	3.8377	+1.3574	2.3223	3.4741	+1.1518
3	Implementing DX in managing professional learning communities through Lesson Study.	F_TC	2.4090	3.7804	+1.3714	2.3573	3.5845	+1.2272
4	Applying DX to establish monitoring processes.	F_TL	2.3304	3.7125	+1.3821	2.2632	3.4718	+1.2086
5	Assigning tasks to teachers based on digital capacity.	F_PC	2.3930	3.7946	+1.4016	2.2889	3.5411	+1.2522
6	Regularly updating learning systems and digital materials.	F_CN	2.3726	3.7504	+1.3778	2.2444	3.5040	+1.2596

For the school manager group, the scores increased with a difference (Δ) from 1.1432 to 1.2596, significantly enhancing management efficiency across all evaluated aspects. This confirms the practical value and scientific basis for proposing a wider application of these measures. Comparison results before and after the experiment for both teachers and managers show that the mean scores of all observed variables belonging to Intervention 2 increased significantly (average increase from 1.18 to 1.48 points), while the standard deviation decreased across most variables. This confirms a clear improvement in perception, implementation capacity, and school-wide consensus regarding the effectiveness of the experimental measures.

In terms of mechanism, BP2 generates improvement through three links: (i) planning is standardized according to competency frameworks and evidence structures; (ii) organization and direction of PLC/lesson study are based on classroom data and learning products; (iii) monitoring and adjustment are based on digital evidence, task assignment according to digital capacity, and update discipline, thereby forming a data feedback loop in the governance of the Physics department.

5. CONCLUSION

The study described and quantified the current status of teaching and the management of Physics teaching at upper secondary schools in the Central Highlands within the framework of the 2018 General Education Curriculum (GEC) and digital transformation. The findings clarify the "bottlenecks" in Physics teaching management: while orientation in terms of planning and professional

development is strong, the operational use of data and control through digital evidence remain weak—particularly regarding the use of digital tools and the PDCA (Plan-Do-Check-Act) feedback loop. By cross-referencing the management framework for subject and lesson plans with survey data, records, and interviews, several core obstacles were identified: the lack of a synchronous digital ecosystem operational mechanism, uneven implementation conditions, a breakdown in data governance for monitoring and adjustment, and unclear accountability.

Consequently, the study proposes a sequence of measures (Intervention 1 – Intervention 2 – Intervention 3) following the logic of "capacity, process, and data/quality assurance". The testing of Intervention 2 (BP2) demonstrated a statistically significant impact ($p < 0.05$) and synchronized improvement for both teachers and managers. This confirms that BP2 serves as the operational core that activates BP1 and BP3 to establish a data feedback loop, enhance management effectiveness, and sustainably improve the quality of Physics teaching oriented toward student competency development, tailored to the specific characteristics of the Central Highlands region.

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